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COMMENTS BY THE SCOTTS COMPANY AND MONSANTO COMPANY

ON THE

ANIMAL AND PLANT HEALTH INSPECTION SERVICE'S

NOTICE OF INTENT TO PREPARE AN ENVIRONMENTAL IMPACT STATEMENT

ON

SCOTTS' AND MONSANTO'S PETITION FOR DEREGULATION OF

GLYPHOSATE-TOLERANT CREEPING BENTGRASS

TO:

Docket No. 03-101-2,
Regulatory Analysis and Development, PPD,
APHIS, Station 3C71, 4700 River Road
Unit 118
Riverdale, MD 20737-1238

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I. INTRODUCTION

The Scotts Company (Scotts) and Monsanto Company (Monsanto) submit these comments in response to the Animal and Plant Health Inspection Service (APHIS)'s notice of intent to prepare an environmental impact statement (EIS) and proposed scope of study, both of which were published in the *Federal Register* on September 24, 2004 (See 69 Fed. Reg. 57257). The EIS will address Scotts' and Monsanto's petition for a determination by APHIS of nonregulated status for a creeping bentgrass (*Agrostis stolonifera*) which has been genetically modified so that it is tolerant to the herbicide glyphosate.

Scotts and Monsanto are pleased to submit these comments in response to APHIS's scoping process.* In this document, we provide comments on the following topics: the proposed alternatives; the appropriate baseline for evaluating the environmental impact of deregulating glyphosate- tolerant creeping bentgrass (GTCB); the environmental consequences of

* Full citations to the technical literature relied upon in these comments are provided in Appendix H.

deregulation; the uncertainty regarding potential environmental impacts; and the proposed mitigation measures. We look forward to timely completion of scoping, publication of APHIS's draft EIS (DEIS) and final (FEIS), and APHIS's Record of Decision (ROD) upon completion of the NEPA process.

II. SCOPING THE EIS

Scotts and Monsanto commend APHIS for the care it took to prepare a detailed Notice of Intent (NOI) regarding the EIS. The NOI poses specific questions that facilitate comment and identify the areas in which APHIS requests input on areas to determine the proper scope of the EIS. While our comments are organized under the core issues to be addressed in scoping an EIS, the comments provide information and perspective on all the questions set out in APHIS's NOI.

A. Discussion of Alternatives: Scope and Context

APHIS described three alternatives for discussion in the EIS:

1. approval of the deregulation petition;
2. denial (the "no action" alternative mandated for discussion by CEQ and APHIS guidelines); and
3. approval of the petition but with any appropriate restrictions deemed appropriate by APHIS to mitigate any anticipated plant pest or adverse environmental effects.

We believe that these three basic alternatives provide adequate scope for discussion of the potential environmental consequences of deregulation. See 40 CFR § 1508.25(b). Further identification of alternatives -- including environmental risk minimization alternatives ("mitigation") -- is unnecessary to satisfy NEPA's requirement for disclosure of the full array of potential environmental impacts and benefits associated with APHIS's deregulation decision.

The basis for any mitigative restrictions on applications of GTCB can emerge from APHIS's alternatives analysis and other regulatory considerations.

B. The Affected Environment

Scotts and Monsanto believe that properly defining the affected environment is crucial in determining the scope of the EIS. The current presence, uses, and control of bentgrasses and relatives in both managed and unmanaged areas should be thoroughly discussed. In this section, we provide information to help define the proper scope of APHIS's discussion in the EIS with respect to the affected environment (CFR § 1502.15). APHIS's discussion of "baseline" conditions will enable it to compare the potential environmental impacts of the proposed action to other reasonable alternative actions (see Section A, above).

In reaching its decision to prepare an EIS, APHIS has already given some attention to existing baseline conditions, focusing on the context and intensity of the proposed action. Under the CEQ regulations, the "context" of the proposed action is the extent to which environmental effects in excess of those created by existing activities or uses may occur. *See* 40 CFR § 1508.27. See also *Hanley v. Kleindienst*, 471 F.2d 823 (2d Cir. 1972), *cert. denied*, 412 U.S. 908 (1973). Scotts and Monsanto have "scoped" the range of issues involved in this section and provided information to enable APHIS to expand its discussion of the history and variety of existing uses of non-genetically engineered creeping bentgrass and other herbicide-tolerant grasses.

The following baseline information should therefore be addressed in an EIS of adequate scope:

1. <u>The extent to which creeping bentgrass and its relatives have been purposefully planted and maintained in the United States over time</u>

Bentgrasses have a long history of unregulated use in the U.S. and are rarely identified as weedy species in situations other than grass seed production or turfgrass of another specie but not as noxious weeds (USDA 2004a). Their widespread presence in the environment, and widespread beneficial use should be considered when evaluating the baseline from which to make comparisons to GTCB.

The EIS therefore should point out that *Agrostis stolonifera* and *A. gigantea* (creeping bentgrass and redtop bentgrass, respectively) are native to the United States (Hitchcock, 1951; USDA, 2004a). Cultivars were also introduced from Europe as forage over 250 years ago, and since have come to be accepted as naturalized. The biology and benefits of creeping bentgrass and important relatives including *A. gigantea* and *A. capillaris* have in fact resulted in their introduction, naturalization, and extensive use beginning as early as the 1700s. Yet although found throughout the United States, these species are rarely considered weedy and not identified as noxious weeds (USDA 2004a). They are recognized, recommended, employed, and maintained for several important functional and environmental purposes, in addition to their recreational and aesthetic applications (See the table of non-recreational beneficial uses of bentgrasses in Appendix A). MacBryde, for example, identified a number of benefits of these species (2004). Bentgrass is also recognized as valuable forage and as providing habitat for wildlife such as the prairie chicken, ring-necked pheasant, bobwhite, and others. These benefits have led to wide adoption and maintenance rather than intentional eradication. Indeed, today it is much more likely that creeping bentgrass will be intentionally planted and maintained rather than eradicated.

Some public comments in the docket have referred to bentgrasses as exotic species and imply that their presence will have a negative impact on native plant restoration efforts. As discussed above, *A. stolonifera* is native to the US. Even if it were exotic, the exotic or non-native status of a plant species does not, in itself, result in a negative impact on the environment. According to the National Invasive Species Council and other scientists, exotic species should be considered for their value in ecological restoration (NISC 2002; Ewell and Putz 2004; D'Antonio and Myerson 2002). Furthermore, as the Society of Ecological Restoration's Primer on Ecological Restoration states:

> An exotic species of plant or animal is defined as one that was introduced into an area where it did not previously occur through relatively recent human activities. Some exotic species were introduced centuries ago by human or non-human agents and have become naturalized, so their status as an "exotic" is debatable. Furthermore, not all exotic species are harmful. Indeed, some fulfill ecological roles formerly played by the native species that have become rare or extirpated. In such instances, the rationale for their removal from natural ecosystems may be tenuous. In restored cultural ecosystems, allowances can be made for exotic domesticated species and for non-invasive exotic ruderal and segetal species that presumably co-evolved with them. These species are acceptable for cultural restoration. At p. 7.

We have provided for APHIS's consideration literature presented in Appendix A, which documents a long history of intentional planting and maintenance of these species throughout much of the United States. These recommended uses clearly demonstrate that *Agrostis* spp. fulfill several important ecological roles and are part of a robust baseline of existing environmental presences.

2. <u>The extent to which bentgrasses and relatives are considered weeds and are controlled by public and private agencies and associations and individuals</u>

The EIS should acknowledge that there are very few situations in which, bentgrasses and relatives, including *Polypogon* spp. are considered "weeds" and are therefore slated for removal. APHIS will need to keep firmly separated in its analysis of (1) the proven need for bentgrass management outside planted areas and (2) speculative predictions of future inability to manage bentgrasses in such areas.

Pursuant to APHIS's request, The Weed Science Society of America conducted an independent and comprehensive review of the weediness of bentgrasses in the United States (Banks et al. 2004). The authors reviewed the published literature and interviewed more than 90 weed scientists, ecologists, and other experts from academia, the USDA Forest Service (USFS), the Bureau of Land Management (BLM), and other institutions. Their study assessed the weed status of bentgrasses in traditional agriculture, grass seed production, and natural and other areas. The study concluded that bentgrasses are rarely considered weeds:

> Creeping bentgrass, and the other *Agrostis* spp. and *Polypogon* spp. with which it can hybridize, are currently widespread throughout the United States. However, where these species occur, they are relatively non-aggressive, their presence is rarely considered a problem that warrants management, and thus they are generally not managed as weeds. Despite the number of species and broad geographical distribution, they have no history as significant weeds of the principal crops in the U.S., other than as infestations in turf and grass seed crops. Overall, this indicates an inherent lack of weedy traits necessary for their adaptation and survival in crop culture. Several of these species have been reported as occasional weeds or as weeds of low importance in fruit, nuts, vegetables, ornamentals, pasture, range, rights-of-way or natural areas, but they were not identified as important, significant, or problem weeds in any of these environments.

The restoration of riparian and grassland areas is an area of study at a number of universities and government agencies. These include the BLM, the USFS, and the USDA's Natural Resource Conservation Service (NRCS). These agencies have published manuals on land restoration, which include guidance for vegetation removal and establishment (Monsen et al. 2004; Bentrup and Hoag 1998; FISRWG 1998; Smith and Prichard 1992). Bentgrasses have often been identified as species to include in restoration activities, because of the numerous ecological roles they fill and benefits they confer. See Appendix A. This use is consistent with the comments of the Society of Ecological Restoration and other restoration experts supporting the use of nonnative species.

3. The extent to which bentgrasses and their relatives can be controlled by chemical and mechanical means

Numerous grass-selective herbicides can be employed to remove bentgrasses. A number of herbicides are as efficacious or more efficacious than glyphosate, have greater selectivity, and are comparable to glyphosate in cost. See Appendix B. More than a dozen herbicides are effective for control of bentgrasses (Banks, et al. 2004). The Nature Conservancy also recommends several of these herbicides for use in natural areas they manage. See: Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas (2001). They include atrazine, bromacil, dichlobenil, hexazinone, imazapic, imazapyr, sulfometuron methyl, diuron, fluazifop-methyl, sethoxydim, diquat, clethodim, sulfosulfuron, and glufosinate. Many of these herbicides are also available to and routinely used by the USFS and BLM, although they have rarely if ever been used for the specific control of bentgrasses (BLM 2002a, 2003a, b; USFS 1994, 2000, 2004a, b).

Information supplied by the BLM through the Freedom of Information Act (FOIA) demonstrates that glyphosate was applied to just 8.7 percent of the 108,719 acres the agency treated with herbicides in 2003 (Appendix C). Since the BLM manages 261 million acres of public land in the U.S., the percent of total BLM acreage treated with glyphosate was 0.0036 percent. The most extensively applied herbicides were 2,4-D and picloram, which were applied to 37.5 and 24.8 percent of the herbicide treated acres, respectively. Most importantly, personal communications with BLM regional pesticide coordinators indicated that these glyphosate and other herbicide applications were not made specifically or with the intent to control bentgrasses. Lack of intentional bentgrass control would also indicate that creeping bentgrass and its relatives are not problematic weed species in natural areas.

In addition to traditional herbicides, BLM is also using mechanical and other means for weed control. For example, in Oregon the BLM is employing Waipuna to combat a variety of invasive weeds, including Japanese knotweed, puncture vine, and false brome (Loos 2004; http://www.waipuna.com/). Waipuna is a coconut-sugar derivative mixed with water and heated to ca. 200^0 F. The resulting foam solution keeps the mixture close to the ground, and the near-boiling temperature effectively kills both perennial non-woody vegetation and their seed bank. Nonetheless, despite the availability of mechanical and herbicide controls, according to regional pest management coordinators for the USFS and BLM (personal communications) and the public record, neither of these agencies is actively targeting the removal of bentgrasses on lands they manage.

The USFS reports that similar to the BLM, 2,4-D and Picloram were the most extensively applied herbicides by the USFS (Appendix C) (http://www.fs.fed.us/foresthealth/pesticide/reports.shtml). These herbicides were applied to 44,412 and 73,580 acres or 21.6 and 35.8 percent, respectively of the 205,682 USFS acres treated with herbicides. Glyphosate was applied to just 6.4 percent of the acres the agency treated with herbicides in 2003. The USFS manages 191 million acres of public land in the U.S., thus the percent of total USFS acreage treated with glyphosate was 0.0069 percent.

We encourage APHIS to ask the USFS to identify the specific weed or plant species targeted for control by these herbicide applications. According to the "Pesticide-Use Management And Coordination Handbook" (FSH 2109.14, Chapter 70, Forms, Reports and Publications), this information should be available through Pesticide Use Proposals (FORM FS-2100-2), which are reviewed and approved before the use and application of pesticides on National Forest System lands. Alternatively, the Post-Treatment Evaluation Report, which is filed within nine months of the pesticide application, must include the name and location of the target pest and the success of the treatment.

Two years of herbicide efficacy data for creeping bentgrass were also included in Scotts' and Monsanto's petition for deregulation of GTCB (pp. 268-71 and 380-428). Researchers at several universities, the USDA Agricultural Research Service (ARS), Scotts, and Monsanto have continued to evaluate the efficacy of a number of herbicides for the control of creeping bentgrass (and GTCB). These recent data are provided in Appendix D. The EIS should address alternative herbicide application approaches and include this information in the EIS in order to disclose the extensive number of efficacious non-glyphosate herbicides capable of controlling bentgrasses, their relatives, and GTCB.

Use of glyphosate is not the most effective means to remove bentgrass species from riparian areas. At label rates, glyphosate provides only partial suppression of bentgrasses; consequently, more than one application would be needed for complete removal (Monsanto 2004). Bentgrass plants to be removed from wetland or riparian areas are likely to be found as small clumps or individual plants not requiring a broadcast herbicide application. These plants can be removed mechanically or can be treated with an herbicide labeled for aquatic use where application to surface water is desired.

The aquatic formulation of imazapyr -- trade name Habitat® -- is also capable of controlling a number of aquatic or riparian weeds. Imazapyr was applied to 6,143 and 1,318 acres by the USFS and BLM, respectively, in 2003 (Appendix C). Habitat can be used in lieu of glyphosate. For example, imazapyr is currently used by the BLM for the control of salt cedar in the New Mexico Chico Arroyo watershed (BLM 2002b). Imazapyr also provides complete control of established bentgrass at rates as low as 0.25 percent acid equivalent per acre (Crockett and Frelich 2004). The cost for such an application is about half that for a glyphosate formulation to achieve equivalent control levels. Imazapyr also has a human and non-target safety profile similar to glyphosate, including a Category E designation as a non-carcinogen (ENTRIX, INC. 2003; Jagan et al. 1987; SERA 1999, 2002; Tu et al. 2001).

The half-life of imazapyr in water is two days. Consequently, if applied to vegetation in zones where the soil is either inundated, or periodically inundated but moist, re-vegetation can occur very quickly. Pole and stem cuttings, which require contact with water, should be unaffected by site preparation treatments with imazapyr. Furthermore, at such low application rates, soil residual activity should be of little concern, if site preparation is performed as recommended in the summer, fall, or early winter before grass seeding (Hoag et al. 2001; Smith and Prichard 1992). In areas where surface water or the potential for drift is not a concern, and an aquatic herbicide is not required, other herbicides registered for the control of perennial grasses may be employed to control bentgrasses. These include clethodim, sethoxydim, and glufosinate, as well as imazapyr.

To protect desirable vegetation, broad-spectrum herbicides should be directed specifically to the target weed via spot spray, a wick applicator, or a barrier (Tu et al. 2001). If a grass-selective herbicide such as fluazifop, clethodim, or sethoxydim is employed, such specific measures would not be necessary, other than to prevent standing or running water from being treated. For example, sethoxydim has been successfully employed in the control of reed canary grass in wetland situations in Wisconsin (Brock 2004).

The efficacy of imazapyr for grassland restoration has been documented. Masters and Nissen (1998), Masters et al. (1996), and Stougaard et al. (1994) evaluated the utility of imazapyr and other imidazolinone herbicides for the restoration of Great Plains grasslands and leafy spurge-infested rangelands. These studies demonstrated that imazapyr and imazethapyr are superior to glyphosate and atrazine, which are also used in the restoration of these areas. The imidazolinone herbicides provided excellent control of noxious weeds such as leafy spurge, musk thistle, Canadian thistle, and spotted knapweed. Application of these herbicides led to the rapid re-establishment of native grasses (big bluestem, switchgrass, and little bluestem) and selected forbs (blackeyed-susan, purple prairieclover, Illinois bundleflower, trailing crown vetch, and upright prairie coneflower). Masters and Nissen (1998) demonstrated that imazapyr was an essential component of treatments applied before planting to facilitate establishment of highly productive stands of tall native grasses (big bluestem, indiangrass, and switchgrass), which are naturally tolerant to imazapyr. Yields of the planted grasses when imazapyr was applied were consistently greater than when glyphosate or no herbicide was applied. In addition, the control of cool-season grasses and leafy spurge with imazapyr was also consistently greater than those treated with glyphosate alone. Based on these studies, the imidazolinone herbicides (including imazapyr) would be effective for restoring grassland to native species. Other grass-selective herbicides are also available if needed to control populations of GTCB, in the event they were to become established. Were GTCB to become established in riparian or grassland areas intended for restoration, non-glyphosate herbicide alternatives are available for its removal that are more effective, require fewer resources, and cost less (Appendix B).

4. The extent to which conventionally-bred glyphosate-tolerant turfgrasses have posed environmental concerns since they became commercially available in 1999

Conventionally-bred, glyphosate-tolerant hard (*Festuca trachyphylla)* and tall (*F. arundinacea*) fescues have been commercially available since 1999 and are offered by Turf Seed, Inc. (2004a, b) under trade names including Aurora Gold® and Pure Gold®. These perennial grasses were also introduced from Europe and are sexually compatible with other *Festuca* and *Lolium* (ryegrass) species. The company markets them for a variety of uses, including home lawns, parks, golf courses, and industrial campuses without restrictions placed on their seed production, use, or specific stewardship or management measures should they become established in unplanted areas. Although the method of their development differed from GTCB, their intended use is essentially the same, i.e., better weed control and turf management through application of glyphosate herbicide (although GTCB will only be sold to golf courses). No negative environmental impact has been documented with the introduction of these plant varieties, and the EIS should consider the lack of environmental effects from these varieties in the analysis of GTCB's environmental consequences.

5. How conventionally bred glyphosate-tolerant turfgrasses have been managed in areas where they may have established and persisted

The EIS should discuss how, if at all, conventionally bred glyphosate-tolerant turfgrass have been managed in areas where they may have established and persisted. Despite their broad use, and their sexual compatibility with other species that may be considered weeds, there have been no reports either in the scientific literature or in the popular press of these varieties' demonstrating harm to the environment. Consequently, no action has been taken by state, local, or federal government to regulate their use.

6. <u>The extent to which creeping bentgrass or its relatives have become established in residential and private landscapes and how they have been managed</u>

The EIS should consider that creeping bentgrass is not a problem in residential and private landscapes, nor is it managed as a weed. Even if it were, several grass-selective or broad spectrum herbicides are available for use, depending on vegetation management goals (See Appendix B). Bentgrasses are often planted for roadside soil stabilization and therefore would be an unlikely target for control (Appendix A). On residential or commercial lawns, glyphosate, imazapyr, and other broad-spectrum herbicides would kill all vegetation and thus are unlikely to be preferred control measures. In such situations, mesotrione and sulfusulfuron would be preferred. They have been reported to provide good selective control of bentgrass in Kentucky bluegrass (Askew et al. 2004; Dr. Nick Christians, Iowa State University; Dr. Domingo Riego, Monsanto, personal communications). Environmental Protection Agency (EPA) registrations for these uses are pending. In traditional agriculture, more than a dozen herbicides are available for use, depending on the crop (See Appendix B). In turfgrass seed production, diuron, oxyfluorfen, and glufosinate may be applied to spot treat bentgrasses and sethoxydim and fluazifop are registered for the selective control of bentgrasses in fine fescue grown for seed. Further, mechanical methods are still employed in grass seed production and turf environments to remove unwanted plants.

7. <u>The extent to which creeping bentgrass or its relatives have replaced native vegetation systems in prairie, meadow, and riparian habitats</u>

APHIS stated in the NOI that some commenters opposed to GTCB have characterized *A. stolonifera* as a major invader of prairie, meadow, and riparian habitats and as a displacer of indigenous flora. When addressing this issue the EIS should consider that *A. stolonifera* and *A. gigantea* have been intentionally planted for forage in many prairie habitats, such as on the Nebraska Great Plains and on Long Island, NY. They continue to be recognized as valuable forages by university range and grassland scientists, the USFS, and the NRCS (See Appendix A). Bentgrass seed production has also been practiced in Oregon, Washington, Idaho, Ohio, Missouri, and southeastern Illinois, the latter of which was once considered the redtop capital of the world (Westemeier 1973). Other seed production areas have included the maritime areas of eastern Canada and the United States. Bentgrass seed is recommended for inclusion in seed mixes for streambank stabilization, riparian buffers, grass filter strips and other uses (Appendix A). Therefore, their presence in these habitats is expected.

Comment has also been submitted citing the potential for *A. stolonifera* and its relatives to directly compete, invade, and change the native habitats of several federally-listed plants and one butterfly species inhabiting vernal pool and prairie habitats in western Oregon, specifically the Willamette Valley and southwest Oregon north of Medford. These species are Nelson's checkermallow (*Sidalcea nelsoniana*), Kincaid's lupine (*Lupinus sulphureus kincaidii*), Willamette daisy (*Erigeron decumbens decumbens*), Bradshaw's lomatium (*Lomatium bradshawii*), Cook's lomatium (*Lomatium cookii*), large-flowered meadowfoam (*Limnanthes floccosa grandiflora*), and Fender's blue butterfly (*Icaricia icarioides fenderi*).

The EIS should consider the following information published by the United States Fish and Wildlife Service (USFWS). The USFWS (1993, 2000a,b) and Pendergrass et al. (1999)

stated that the habitat of these species is primarily threatened by: industrial and residential development; road and powerline construction, improvement and maintenance; agricultural and silvicultural practices; logging; recreational activities; certain grazing practices; gold mining; woody species encroachment resulting from fire suppression; over-collection; and herbicide use. Although competition with non-native plants was mentioned, there is no indication that *A. stolonifera* or its relatives have contributed to, or are contributing to, the displacement of these species. This is especially significant because the Willamette Valley has been the principal bentgrass seed production area of the U.S. for the past 75 years. Furthermore, as herbicide use is noted as a reason for habitat destruction, glyphosate, because of its non-selectivity, would be a poor choice for the control of *A. stolonifera* or its relatives were they threatening the habitats of these species. As vernal pools are by definition seasonal wetlands, a non-aquatic grass-selective herbicide could be applied when standing water is not present to control *A. stolonifera* or its relatives if needed. These applications could be done without affecting the listed species, none of which are grasses.

8. The extent to which creeping bentgrass hybridizes with other *Agrostis* or *Polypogon* species

The EIS should consider the extensive literature reviews and/or research performed by MacBryde (2004), Christoffer (2003), Belanger et al. (2003), and Scotts and Monsanto (Petition pages 256-267 and 363-379) regarding the potential for *A. stolonifera* to hybridize with other species and the relative fitness of those hybrids. Watrud et al. (2004) also examined *A. stolonifera* pollen flow and found very low rates of crossing with *A. gigantea* that decreased rapidly with distance from the pollinating source. Further, sentinel plants were nearly 100 times more likely to produce seed from outcrossing with the transgenic pollen source than were resident plants, suggesting strongly that pollen competition and proximity of the pollen source are over-riding factors in outcrossing between *Agrostis* populations.

In addition, extensive collections of *Agrostis spp.* have been made by plant breeders to develop varieties of bentgrass for a variety of applications. In the process of making these collections, an abundance of "real-life" information has accumulated regarding the presence of creeping bentgrass and hybrids in natural environments. Dr. Leah Brillman submitted comment to the Agency during the January – March 2004 comment period (comment #369), which may be valuable to APHIS. Dr. Brillman stated:

> The misidentification of creeping bentgrass, *Agrostis stolonifera*, in the literature and by many individuals has led to a perception that it is present in many more locations than it is actually found. I collect bentgrass species on golf courses, old cemeteries, parks, fields and other sites, particularly in low maintenance and other high stress areas. The only place I have collected plants that after being grown out proved to be creeping bentgrasses was on golf courses.
>
> As part of my collection in addition to looking for each bentgrass species I have also looked for hybrids. I have only found two plants in my thousands of plants that I considered hybrids between colonial and creeping bentgrass. These two plants were from the same course in Massachusetts and the course history suggested they might have been seeded with seed from Europe. These plants had low fertility and were crossed with colonial and creeping bentgrasses. It was three more generations later before I thought the fertility levels were close to normal. I think some crossing will occur but the evidence is no more will occur than before with non-transgenics and these have not become significant weeds or invaded natives with crosses.

9. <u>The extent to which creeping bentgrass or its relatives have hybridized with other sensitive *Agrostis* species</u>

The EIS should consider the historical interaction of conventional *Agrostis stolonifera* with sensitive *Agrostis* species in nature. We are unaware of any case where *A. stolonifera* has hybridized with any sensitive *Agrostis* so that management of these populations had to be undertaken by any federal agency.

No *Agrostis* species are on the Fish and Wildlife Service's list of endangered species (USFWS 2004). However, three *Agrostis* species are considered to have special status by the USFS, *A. hendersonii*, *A. howellii*, and *A. mertensii*. The National Park Service considers *A. rossiae* to have a similar status. The California Department of Fish and Game also commented on the status of *A. blasdaleii, A. clivicola var. punta-reyesensis, A. clivicola var. clivicola, A. hendersonii, A. hooverii,* and *A. humilis.*

The EIS should consider the taxonomy, biology, habitat, and location of sensitive *Agrostis* species to assess whether they are synonymous with widely distributed *Agrostis* spp., are sexually compatible, or are likely to inhabit environments similar to those inhabited by *A. stolonifera* or its known sexually compatible relatives. In addition, the specific locations of these sensitive *Agrostis* species are available from the Heritage Programs of states in which these species reside. APHIS can use this information to better assess the current potential for *A. stolonifera* to hybridize with these species.

Agrostis howellii is synonymous with *Calamagrostis howellii*, which is not listed as having special status by either the USFS or the state of Oregon (USDA, 2004). *Agrostis howelli*, however, has been recorded only within the Oregon counties of Hood River, Linn, Jackson, and Multnomah, parts of which are situated within the Cascade Mountain range (USDA, 2004, Oregon Natural Heritage Program 2004). These populations have been routinely exposed to bentgrass pollen originating from the Willamette Valley of Oregon where greater than 90 percent of all bentgrass seed is produced. APHIS can obtain the specific locations of these populations in Oregon from the Oregon Natural Heritage Program.

Agrostis hendersonii is synonymous with *A. exarata* and *A. microphylla* (USDA, 2004). *A. exarata* is broadly distributed throughout the Western U.S. *A. microphylla* has been identified in Washington, Oregon, and California, while *A. hendersonii* has been identified only within the California counties of Shasta, Butte, Calaveras, and Merced (USDA, 2004). These counties are within or near the California Sierra Nevada Mountain range (California Natural Diversity Database 2004). Although cited as present in Jackson County, Oregon, in 1930 by Hitchcock (1951), there is no record of *A. hendersonii* in Jackson County since 1980 (Oregon Natural Heritage Program 2004).

Agrostis mertensii is synonymous with *A. borealis* and *A. idahoensis*. The latter species is broadly distributed throughout the Western U.S. and is sold commercially as the variety Golfstar. *Agrostis mertensii* is a facultatively upland species, which is typically found in alpine, dry, rocky, and turfy places on acidic rocks. In contrast, *A. stolonifera* is a facultative wetland species common to riparian areas. *Agrostis mertensii* is restricted to isolated mountainous regions in a few counties of the states of AK, CO, ME, MT, NC, NH, NY, TN, UT, VA, VT, WA, WY, and WV yet has state-protected status only in ME, NY, TN, VT, WA, and WV. The species is listed to occur within just four of the 175 national forests or grasslands: Monongahela, Green Mountain, White Mountain, and Cherokee. Due to the isolated, predominantly dryland location of *A. mertensii*, the rarity of its occurrence, and the intended use and predominantly natural riparian habitat of *A. stolonifera*, it is highly unlikely that gene flow will occur from a golf course or seed production area. The specific locations of these populations may be obtained from the State Natural Heritage Programs.

Agrostis rossiae is synonymous with *A. variabilis*, which is broadly distributed throughout the Western U.S. (USDA 2004). *Agrostis rossiae* is an annual, is considered the only strictly thermal species of *Agrostis*, and is endemic to the thermal areas of Yellowstone National Park (Swallen 1948; Tercek and Whitbeck 2004). Seeds of *A. rossiae* germinate in December through January, when nonthermal habitats in Yellowstone are covered with snow. *Agrostis rossiae* reaches anthesis in late May and is killed by rising soil temperatures in mid-June (Tercek and Whitbeck 2004). There is no record of *A. rossiae* hybridizing with *A. stolonifera* because the latter is nonthermal and prefers cool-season environments with low environmental stress (Hunt *et al.* 1987).

The available data on bentgrasses suggest that some hybridization may occur, with unlikely but possible limited introgression at some time in the future. The EIS, however, should address, not the mere possibility of hybridization/introgression, but rather the lack of significant environmental consequence from any hybridization/introgression that in fact does occur. In NEPA analysis, low-probability low-consequence potential outcomes do not require the same level of NEPA disclosure and analysis that high-probability high- (or low) consequence, or low-probability high-consequence, potential outcomes do. Hybrids that may carry the modified gene will be no better equipped to survive in a natural or unmanaged environment than GTCB itself, since many herbicidal agents are available in addition to glyphosate-based products.

There are no published data or references of which we are aware that substantiate that *A. stolonifera* or its relatives have affected the persistence of the sensitive *Agrostis* species identified above. However, were bentgrasses to occur in areas where sensitive *Agrostis* or other plant species reside, the USFS, BLM, and others have published guidelines or methodology to ensure herbicides can be effectively applied to control only the targeted weed.

10. <u>The extent to which efforts have been made by public or private agencies or associations to mitigate the impact of *A. stolonifera* or its relatives on sensitive *Agrostis* species</u>

As an indication of the potential impact on sensitive species, the EIS should determine if programs to specifically protect the sensitive species mentioned just above are currently in place. Personal communications with the rare plant coordinator of the USFS indicate that the Forest Service has no programs at all specifically targeted to maintaining or increasing these species or protecting them from competing vegetation, other than listing them as "sensitive." Furthermore, other than a type sample of *A. mertensii* collected from Greenland, samples of *A. hendersonii, A. howellii, A. rossiae, A. blasdaleit, A. clivicola var. punta-reyesensis, A. clivicola var. clivicola, A. hendersonii, A. hooverii,* and *A. humilis* are not among the 338 accessions maintained for other *Agrostis* species in the USDA ARS National Genetic Resources Program (NGRP). The NGRP houses a collection of more than 460,000 accessions representing 10,700 plant species. At the minimum, it would seem that type samples for these sensitive *Agrostis* species would be maintained to ensure their preservation along with other sensitive plant species such as *Lesquerella lyrata, Limnanthes floccosa, Trifolium stoloniferum, etc.*

11. <u>The extent to which creeping bentgrass or its relatives have become established in traditional and glyphosate-tolerant agricultural systems, including turfgrass seed production, and how have they been managed</u>

In addition to the comments contained within the WSSA document cited earlier (Banks, et al. 2004), the EIS should consider the comments of the dozens of academic weed scientists, agronomists, turfgrass seed producers and farmers who provided expert opinion on the limited potential of bentgrass as a weed in traditional and glyphosate-tolerant agricultural systems. These include: Diesburg (37), Gardner (39), Fitzpatrick (40), Cenex Harvest States (56), Reichert (91), Beck (151), Millberger (163), Stier (221), Kirsch (223), Olson (231), Weber (247), Kraemer (264), Eblen (335), Pepin (381), Reinbold (411), Askew (433), and Kenna (452).

As previously noted, Banks *et al.* (2004) stated that "Despite the number of species and broad geographical distribution, they [bentgrasses and *Polypogon* spp.] have no history as significant weeds of the principal crops in the U.S., other than as infestations in turf and grass seed crops." The EIS should also discuss a report compiled by the Oregon Seed Certification Service on contaminants found in turfgrass seed test reports. The Oregon Seed Certification Service found that bentgrass seeds were not among the top ten most frequent contaminants found in the turfgrass seed lots tested. Additionally, for each individual turfgrass seed crop, bentgrass was not among the top five most frequently noted contaminants, except where colonial bentgrass appeared as a contaminant in creeping bentgrass seed lots. The report from OSCS covers 2000 through 2003 and is attached as Appendix E.

12. <u>The extent to which creeping bentgrass or its relatives have become established in unintended areas of golf courses and how have they been managed</u>

The EIS should discuss the perspectives and information provided in the letters submitted during the comment period, which contain the expert opinion of golf course superintendents and other golf professionals regarding the weed status of bentgrasses on golf courses and the methods for their management. These include comments by: Kane (43), Burch (23), Witte (123), Cross (161), Tibbels (314), and Roseberry (326). These comments demonstrate that creeping bentgrass has never posed management problems for golf courses due to movement of the bentgrass into unintended areas.

C. **Environmental Consequences**

Whereas hybridization can occur and has likely been occurring throughout the history of *Agrostis*, neither *Agrostis* nor its hybrids have become problematic weeds. Consequently, no efforts to control them have been documented in any substantial form. The potential of *Agrostis* to be managed as weeds has received attention primarily because of the comments arising in opposition to GTCB development since its public disclosure.

NEPA requires APHIS to address the direct, indirect, and cumulative potential impacts of any major federal action that could significantly affect the human environment. However, in the case of the deregulation of GTCB, direct negative impacts are virtually non-existent. This is because unlike other major federal actions subject to EIS requirements, GTCB deregulation will not entail environmental disruption comparable to that which may be occasioned by a housing, energy, natural resources development, or other project involving a major federal action. The direct effects of deregulation are primarily beneficial. Potential indirect effects, some of which are uncertain and speculative, apparently occasioned the preparation of the APHIS EIS. Cumulative effects are even more uncertain. Appendix F summarizes the direct, indirect, and cumulative potential impacts of deregulating GTCB.

Under NEPA, agencies are to address "reasonably foreseeable significant adverse effects." See CEQ Guidelines § 1502.22 (preamble). NEPA regulations and case law do not require the agency to engage in uninformed speculation and worst-case scenario projections. See, e.g., *Presidio Golf Club v. National Park Service*, 155 F.3d 1153 (9^{th} Cir. 1998) (agency is not required to discuss the indirect effects of an action if they are remote or speculative.) "NEPA 'does not require a "crystal ball" inquiry.' *Natural Resources Defense Council v. Morton*, 148 U.S.App.D.C. 5, 15, 458 F.2d 827, 837 (1972)." *Vermont Yankee Nuclear Power Corp. v. Natural*, 435 U.S. 519, 534 (1978). Nor does NEPA require the agency to develop new data or carry out additional research to resolve uncertainties and answer open questions. See CEQ Guidelines § 1502.22. NEPA simply requires that the agency disclose and analyze available information, including disclosure of uncertainties.

To address reasonably foreseeable impacts, the EIS should consider the extensive body of knowledge that exists regarding the methodologies for restoring land and vegetation. The literature should be reviewed to assess the intended land uses to put into proper perspective the control of undesired grasses or GTCB.

In discussing the potential indirect environmental side-effects of measures taken to manage any GTCB that may survive outside zones of intended application, APHIS should again be guided by the NEPA rule of reason. CEQ Guidelines § 1508.8(b) imposes the sensible requirement that in assessing indirect effects (i.e., effects, which may be "later in time or farther removed in distance"), only indirect effects that are "reasonably foreseeable" need be assessed.

In addition, potential beneficial effects should also be addressed. *Id.* Effects are broadly defined to include ecological, aesthetic, historic, cultural, economic, social, and health effects -- whether direct, indirect, or cumulative. Discussion of the economic, social, and other benefits is just as necessary as discussion of environmental impacts in order for the Agency's crucial comparison of alternatives to be fully informed (See A, above). The EIS should weigh carefully the information presented here, as well as the scientific literature, to put into context the impact GTCB may have in areas intended for restoration or on the human environment. In preparing an EIS of proper scope, as we stressed above, APHIS will need to keep in mind that bentgrasses are often specifically and deliberately employed for restoration and stabilization. The incremental difference made by the presence of a genetically modified trait for glyphosate tolerance is extremely small. Glyphosate tolerance confers no other competitive ecological advantage on bentgrass.

That said, in instances where bentgrass removal -- including future GTCB removal -- is desired, one or more other control options exist. As discussed previously, these may already be preferred over glyphosate. Most of the herbicides identified in section B, above, and in Appendix B carry the identical precautionary statements on their label as the different glyphosate formulations carry on their labels. These herbicides pose minimal risk to the environment or the applicator if applied according to the label. In many instances, the cost of these herbicides is comparable to that of glyphosate as well.

Scotts and Monsanto urge APHIS in the strongest terms to reject the *a priori* concept that the release of GTCB (or any other genetically modified plant) constitutes, in and of itself, environmental "impact" under NEPA. For GTCB, such an approach would not be supported by the credible scientific evidence, would be based on conjecture, and would fall outside the rule of reason that CEQ and APHIS guidelines and NEPA case law require agencies to follow in addressing potential environmental impacts. Each genetic innovation and release pathway needs to be individually evaluated, depending upon available studies, data, modeling, and the nature of the genetic modification. APHIS concluded in its preliminary risk assessment that other than tolerance to glyphosate, GTCB is not different from conventional creeping bentgrass (USDA 2004). Consequently, there is no scientific justification to support a conclusion that GTCB would pose a greater environmental risk, become more of a weed, or become more difficult to control than conventional bentgrasses, which have some inherent tolerance to glyphosate (Monsanto 2004). Furthermore, were establishment and persistence to occur in situations where GTCB is unwanted, unintended or unexpected, no selective advantage is conferred by the additional tolerance to glyphosate provided by the *epsps* gene in the absence of the herbicide. (Meagher et al. 2003; Hancock 2003; Quemada 1999; Tasker 2003).

1. <u>Control of weeds on golf courses with the GTCB system</u>

Monsanto is in the process of registering Roundup PRO® herbicide, for use with GTCB. Use instructions for this product will reflect five years of testing with GTCB. Monsanto has also developed a comprehensive weed management plan for this use that has been vetted with leading academics in turfgrass weed control. All weeds on golf courses would be controlled or suppressed by glyphosate under a GTCB planting program. That said, *P. annua* (annual bluegrass) is the most important weed appearing on golf greens. Further, *P. annua, Digitaria spp., P. trivialis, Eleusine indica,* and *Trifolium repens* are the main weeds appearing in fairway turf. *Taraxicum officinale, Stellaria media, Cyperus spp.*, and *Kyllinga spp.* also occur in fairway turf. All of these weeds, persistent though they are at present, can be effectively managed by planting GTCB and using glyphosate for weed control.

Most weeds on greens and fairways can be controlled with selective herbicides today; however, it often requires a variety of different products (pre and post emergence and broadleaf and grassy weed control products plus growth regulators) to control the complete spectrum of weeds that occur, because most selective herbicides have a rather narrow spectrum of control. It is important to note, though, that *P. annua* cannot be effectively controlled by any of the products currently available in golf. Among existing herbicides, glyphosate is used today only for trim and edge use around structures and cart paths and for renovation of turf. Use of GTCB allows glyphosate to be used for selective control of *P. annua* on greens, fairways, and tees.

a. <u>*Poa annua*: a special case</u>

Poa annua is the most important weed that occurs on golf courses. It is not effectively controlled by herbicides currently available and thrives in aggressive mowing regimes such as are common in golf. The problems presented by *Poa annua* thus require more examination, to see why GTCB deregulation is critical to improving golf course turf management.

Poa annua is typically an annual species that must flower and produce seeds each year to survive in a turf stand. Annual grasses such as *P. annua* spread by seed, and *P. annua* is a prodigious seed producer. This is a most unusual plant, in that it can still produce seed at the severe mowing heights found on golf greens (3/16ths of an inch or less). Herbicides, growth regulators, and even fumigants are employed in the battle against this weed, with virtually no success. Control of *P. annua* has been the scourge of golf course managers for many years. Course managers eventually have to "co-manage" this weed, i.e., fight a losing battle with it as it reappears in golf course turf. *Poa annua* thus will be the most frequent target for applications of GTCB. *Poa annua* is easily controlled by one quart of Roundup PRO per acre, the lowest rate on the pending label.

The facts have direct relevance to the scope of the EIS. In its alternatives analysis in the EIS, APHIS will need to take into account the unavailability of any effective control alternative for *P. annua* other than GTCB and glyphosate, the substantial overall reduction in herbicide use expected to be realized by the GTCB system, the substantial gains in *P. annua* control, and the small quantities of glyphosate that will achieve these benefits. One of the critical objectives of the deregulation, which is the major federal action on which the EIS will be prepared, is control of golf course weeds for which no effective alternative control regimes exist. If or when effective herbicides become available for *P. annua* control, GTCB would provide an alternative mode of action to protect against potential weed resistance to those other products.

b. Rate and frequency of application of glyphosate

In general, rates of glyphosate application on GTCB are expected to range from one to three quarts per acre. Up to four applications per year are permitted in the pending labels. In practice, experience has taught that one or two applications will provide a weed-free stand of turf. Once a thick, healthy stand of turf is developed, only occasional applications of Roundup PRO herbicide have been required to maintain adequate weed control. These secondary applications may only be needed via spot spray application of glyphosate. Some experts have extrapolated this to the need for an application only once every two years.

c. Current negative environmental impact of using fumigants to eliminate *P. annua* so greens can be planted with conventional bentgrass

The most negative environmental factor associated with weed control in conventional bentgrass is the use of fumigants such as methyl bromide to control *P. annua* during the establishment of greens. Use of the GTCB system is expected to reduce the use of the fumigants. Fumigants are used to reduce or eliminate the seed bank of *P. annua* in the soil. To accomplish this, a fumigant essentially kills all life in the soil, including microbes, fauna, and of course, any seeds present. Resorting to fumigants provides an indication of the difficulty presented by *P. annua* to course managers.

d. Rates required for control of specific weed targets

As stated above, one quart per acre of Roundup PRO herbicide will effectively control *P. annua*. The same rate will easily control most other common annual grass species such as crabgrass (*Digitaria spp.*), roughstalk bluegrass (*P. trivialis*), and Goosegrass (*Eleusine indica*) -- one quart per acre. In the case of broadleaf weeds, the most common problem is a perennial, white clover (*Trifolium repens*). White clover can be managed with an application of three quarts per acre of Roundup PRO herbicide. Other options such as phenoxy mixtures may be more economical choices for this species. Most other annual broadleaf weeds are easily controlled by one quart per acre of Roundup PRO herbicide.

2. <u>The likelihood GTCB will establish and persist in off-site locations or that GTCB will hybridize and introgress in bentgrass-related species</u>

Any suggestion of harm from the establishment and persistence in off-site location of GTCB or its relatives is purely speculative. Accurately predicting such an outcome at this early date involves conjecture about overly remote and speculative risks that can only be defined after the implementation of the proposed management practices.

APHIS should employ the concept of familiarity in the discussion of *Agrostis* hybridization. Despite the fact that hybridization has likely been occurring for centuries, *Agrostis* and its hybrids are not reported as problematic weeds. Although reports of putative hybrids are found in the literature, they tend to be infrequent and seldom verified and are not described or recorded as problematic in any crop or ecosystem.

Furthermore, APHIS should consider both the data submitted in our petition for deregulation, and the conclusions of APHIS's preliminary risk assessment, which support the conclusion that the only difference between GTCB and conventional bentgrasses is GTCB's tolerance to glyphosate herbicide. Since tolerance to glyphosate does not confer an adaptive advantage in the absence of the herbicide, and as described above, bentgrasses are rarely considered weeds and can easily be controlled if desired, GTCB would be no more likely than conventional bentgrasses to hybridize with related species, establish and persist in unintended locations, or become a weed problem.

3. Supplementary or alternative weed and weed-tolerance reduction measures

A number of practices have been used to reduce the potential for development of resistant weed populations in crops. These include avoiding repeated low rates of application that facilitate development of resistance, use of cultural or mechanical methods along with herbicides for control, inclusion of diverse modes of action in control programs over time, and avoidance of high-frequency application regimes. Crop competition has historically been an important tool in weed management. Prior to the invention of herbicides, growers used planting date and early cultivation to establish a crop canopy for purposes of overcoming weed competition. The basis for performance with most preemergent, selective herbicides has been to provide a weed-free environment during the establishment of the crop. To the extent that crops are able to smother out weeds, weeds are unable to produce seeds, and weeds that do not survive do not develop resistance.

Management options exist for golf courses that do not exist to the same extent in other situations. Turfgrass differs from many other crops in that it can produce dense canopies of vegetation that can provide little opportunity for weeds to compete for light, water, and other nutrients. Traditional management practices such as regular mowing, further reduces the competitive ability of weeds and their ability to produce seed. Consequently, if weeds do not become established early, they will lose the opportunity to invade a stand of turf. Experience with GTCB in turf corroborates these observations. Applications of Roundup PRO herbicide made soon after emergence have eliminated *P. annua* from the stand and allowed a weed-free establishment of bentgrass that lasts for an extended period.

4. Potential increased prevalence of glyphosate-tolerant weeds as a result of GTCB use

The likelihood of the development of glyphosate-tolerant weeds, such as *P. annua* in GTCB stands is low if a sound weed management plan is employed. Weed resistance develops relatively rarely with glyphosate compared to most other active ingredients. The 30-year history of this herbicide has been typified by very reliable performance when labeled rates are used as a part of an appropriate weed management plan.

Beyond these general observations, it is virtually impossible to predict the timeframe for development of weed resistance since it is impacted by the behavior of users, environmental variables, the biology of the weed, the system in which the weed occurs, and the characteristics of the herbicides used to control it. Further, a GTCB system will provide an additional tool that is wholly compatible with other cultural management methods and other herbicides currently in use or in development. Again, in addressing these issues in the EIS, APHIS will need to be guided by the rule of reason under NEPA and address only reasonably foreseeable consequences.

5. Benefits

We stated above the relevance of benefits analysis to EIS preparation, stressing both the necessity of discussing benefits as an input to APHIS's alternatives analysis, and the broad scope of the types of benefits to be discussed. We also point out that nearly 340 individuals wrote in support of GTCB benefits during the public comment period initiated by APHIS in early January of 2004. APHIS must consider these benefits in its EIS when discussing the potential environmental impacts of deregulating GTCB. Also, both the CEQ and APHIS have noted the relevance of public and non-federal comment, involvement, and concern at many points throughout their guidelines.

a. The extent to which well-managed turfgrasses provide social, environmental, and other benefits

Turfgrasses have been purposefully maintained to enhance the quality of the human environment for more than a thousand years. Approximately 50 million acres of turf are managed in the U.S., which makes it third in total acreage among managed plants, including agricultural crops (National Turfgrass Research Initiative 2003). The USDA's Economic Research Service estimates that the turfgrass industry in all its forms is a $40 billion industry (1999). When considering the benefits of GTCB use on golf courses, APHIS should discuss in the EIS the important benefits of well-maintained turf and the literature supporting these benefits to our environment and health.

The environmental, aesthetic, and health benefits of well-maintained turf are extensively documented and summarized below (Beard and Green 1994; United States Golf Association 1994a, b, 2004; The Scotts Company 2002; National Turfgrass Research Initiative 2003). The adoption of GTCB on golf courses and the use of glyphosate for post-emergent weed control will further enhance the ability to realize these benefits in the same manner as herbicide tolerant soybeans, corn and cotton have facilitated the adoption of conservation tillage practices and the subsequent realization of its benefits (Fawcett and Towery 2002).

Functional benefits:

Reduction of soil erosion and dust stabilization
Soil improvement and restoration
Groundwater recharge and surface water quality
Organic chemical decomposition
Dust prevention
Heat dissipation and temperature moderation
Noise abatement
Glare reduction
Air pollution control
Nuisance animal reduction
Decreased noxious pests

Weed-related allergenic pollen reduction
Direct and indirect support of extensive animal biodiversity
Fire hazard reduction

Recreational benefits:

Low-cost, sustainable surfaces for outdoor sports and recreational activities
Physical and mental health
Injury reduction

Aesthetic benefits:

Quality of life
Mental health
Social harmony
Community pride
Complement to trees and shrubs

Economic benefits:

Increased property values
Employment
Maintenance expenditures
Related industries

b. <u>The extent to which golf courses provide social, environmental, and other benefits</u>

The game of golf originated in Scotland in the mid-fifteenth century and was played in North America as early as 1659. Golf is enjoyed by people of all ages, nationalities, and income levels for its health, social, and recreational benefits. Golf courses provide important green space for urban areas and serve as wildlife corridors for many plant, bird, and animal species.

There are 15,827 golf courses in the United States, which maintain about 1.84 million acres of turfgrass (National Golf Foundation 2004). However, more than 70 percent of the acreage of golf courses are rough and non-play areas, including woods, water, grasses, and stands of trees and shrubs (United States Golf Association 2004). Combined with the open areas of fairways and greens, a golf course may offer an attractive wildlife and wetland sanctuary with food, water, and cover for many species of birds, deer, small mammals, amphibians, and other fauna and flora. Golf courses help conserve biodiversity, particularly near urban and highly developed suburban areas. Non-play areas provide corridors that link natural areas and provide excellent buffers around ecologically sensitive sites or protected woodlands and wetlands. As outstanding examples of "brownfields" renewal projects, golf courses may also be designed as attractive and environmentally sound uses for closed landfills and other ecologically damaged sites.

Golf course superintendents who oversee management of the golf course landscape are among the best-educated and most conscientious users of chemical management tools. Most have two- or four-year university degrees in agronomy, horticulture, or another related field (Golf Course Superintendents Association of America 2004). The United States Golf Association (USGA), the Golf course Superintendents Association of America (GCSAA), Audubon International, and the American Society of Golf Course Architects are leaders in providing guidance on how to develop and maintain golf courses to enhance their environmental benefits and sustainability.

In collaboration with the USGA, Audubon International initiated the Audubon Cooperative Sanctuary Program for Golf Courses (ACSP), an environmental education program designed to help golf courses play a significant role in enhancing and protecting wildlife habitats and natural resources, while reducing environmental risks. As of July 2004, over 2,200 golf courses are enrolled in the program (about 14 percent of all U.S. golf courses), and 491 courses have achieved designation as a Certified Audubon Cooperative Sanctuary in the United States by implementing and documenting a full complement of conservation activities (Audubon International 2004). These activities include:

- Integrated pest management programs, so that applications of pesticides and fertilizers are made only on certain portions of the golf course and on an as needed basis only;
- Proper application of pesticides and fertilizers to reduce the potential for leaching or runoff into water supplies;
- Maintenance of non-play areas without using turf care products so such areas include a diverse variety of native plants and trees;
- Composting of grass clippings and leaves, which reduces landfill waste;
- Stocking permanent or seasonal wetlands with native plants to support wetland birds and wildlife, such as wood duck, great blue heron, deer, muskrat, amphibians, and other species;
- Use of natural features to improve the course ecology such as dead trees, which provide nesting cavities, as well as employing nesting boxes for bluebirds, purple martins, and other species;
- Replacing turf with drought-tolerant plant materials and developing long-range landscape plans that cluster plantings according to their water needs; and
- Use of recycled or treated waste water for irrigation and reduced overall water usage without adversely affecting the playability of the course.

c. <u>The extent to which glyphosate tolerance will increase benefits</u>

Creeping bentgrass is employed by golf courses principally because it is a perennial plant that provides a dense uniform playing surface that tolerates traffic and can be managed successfully at low heights. However, more than 30 annual and perennial grasses and broadleaf and sedge species invade golf turf (Beard 1982). These weeds are currently controlled with variable success using a variety of herbicides, fumigants, and plant growth regulators that are applied throughout the growing season. Consequently, some estimate that 2.4 million pounds of pesticide-active ingredients are annually applied for pest control on creeping bentgrass golf courses (Harrison 2002). Adoption of GTCB by golf courses will both simplify and improve the efficacy of weed control and turf management as a whole. The ability to treat turfgrass directly with glyphosate herbicide will significantly reduce the need for many other herbicides, fumigants and plant growth regulators.

The grassy weeds pose the greatest control problems because of the lack of species-specific herbicides. Many of these, such as Johnsongrass, quackgrass and yellow nutsedge, are also listed as noxious weeds by a number of state departments of agriculture (USDA 2004; Appendix G).

The most challenging grasses to control in creeping bentgrass tees, greens, and fairways are *P. annua* and *P. trivialis* because of their similar ecological adaptations to bentgrass. In particular, as described previously, *P. annua* is troublesome because it thrives and disperses viable seed under the same mowing, irrigation, and fertilization regimes as *creeping* bentgrass grown for fairway and putting green uses. Without effective weed control options for *P. annua*, golf course managers have to co-manage this weed along with bentgrass to maintain the turf in suitable condition for play.

Although *P. annua* has limited utility as a perennial turfgrass, it suffers from a variety of cold hardiness, heat tolerance, and other maintenance problems. It has disease and insect susceptibility problems to which creeping bentgrass is not susceptible. Most important, *P. annua* frequently fails under the heat and drought stress conditions of midsummer without aggressive intervention with water, fungicides and growth regulators, because it is best adapted to cool, moist conditions. The result of its aggressive cool-season colonization and marginal warm-season survivability is that golf course superintendents invest a great deal of labor, chemistry, water, and intellectual energy into co-managing mixed stands of *P. annua* and creeping bentgrass – either in an attempt to eliminate the *P. annua* or to encourage its survival in situations where control strategies have proven futile. Fungicide and insecticide applications are also made to manage pests of annual bluegrass. Harrison estimated that 415,000 pounds of pesticide-active ingredients could be reduced through the adoption of GTCB and consequent ability to eliminate annual bluegrass (2002). Doing so would further enable the course manager to focus on managing just creeping bentgrass. A dense, uniform, weed free sward of creeping bentgrass is less susceptible to diseases, insects and other biotic and abiotic stressors, which further enhances the ability to successfully employ a greater diversity of "softer" cultural and mechanical measures to control pests when needed.

Reductions in the use of pest control products have been realized in other glyphosate tolerant crops and it is likely that GTCB will provide similar benefits. For example, Brimmer et al. (2004) reported that between 1995 and 2000 the amount of herbicide-tolerant canola planted in Canada increased from 10 percent to 80 percent of total acreage. This was accompanied by a 40 percent decrease in herbicide use and a 36 percent decrease in environmental impact, calculated by human and animal toxicity and environmental persistence. The decrease occurred because farmers growing herbicide-resistant crops can use just one or two applications of a broad-spectrum herbicide such as glyphosate and can target weed-infested areas while crops are growing rather than spraying entire fields before planting.

To provide further perspective on the potential for pesticide reduction from GTCB and glyphosate, the BLM and USFS combined applied 303,293 pounds of pesticide active ingredient to the 452 million acres of land they managed in 2003 (BLM 2004; USFS 2004). In contrast, Harrison (2002) estimated that 2,381,904 pounds of pesticide active ingredient were applied to the 14,940 courses with creeping bentgrass greens and/or tees and 2,297 courses with creeping bentgrass fairways. Harrison further estimated that if GTCB were planted on these golf courses and glyphosate was used for weed control, 415,083 pounds of pesticidal active ingredient could be eliminated annually, even with an increase in glyphosate application. Therefore, by adopting this technology, golf course superintendents have the potential to reduce the application of 111,707 *more* pounds of pesticidal active ingredient annually than was applied by the USFS and BLM, *combined*, in 2003. When placed in this context, such a reduction in potential pesticide use must be viewed as a significant benefit.

6. Threatened and endangered species

CEQ and APHIS guidelines, pursuant to NEPA itself and the case law thereunder, admonish that EIS discussion of potential environmental impacts should be scoped under a rule of reasonableness. Without venturing into unduly remote and speculative inferences, the EIS should reflect that there is no greater potential for GTCB to introgress into special status *Agrostis* species compared to conventional bentgrass based on the following factors:

- GTCB is not different morphologically, phenotypically, and reproductively from conventional bentgrasses, other than its tolerance to glyphosate;
- *Agrostis* species are both native and naturalized in North America for more than 250 years without development of established hybrid populations with these special status species;
- These species do not reside in areas where GTCB seed would either be produced or grown on golf courses;
- GTCB is not reported to have flowering characteristics different from those observed for other *A. stolonifera*, and there is no reason to believe that it would have a greater ability to produce fertile hybrids with these species (USDA GTCB Petition, Sections VI and VII).

In addition, the potential for GTCB to directly or indirectly impact other threatened or endangered (T&E) plant and animal species through competition or the use of non- glyphosate herbicides for control must also be considered. To aid in the evaluation of these impacts, the draft EIS should consider the endangered species assessment performed by Compliance Services International (2004) at the behest of the Department of Environmental Sciences of Monsanto Company. This assessment was performed to address the potential risks of certain herbicides to federally listed T&E species as a result of the possible off-target impacts from planting of GTCB for seed production in three locations in Oregon and Idaho. The report will be submitted to APHIS separately. However, the results were clear in demonstrating that:

Of the six T&E species existing in the potential use area, three (Sockeye and Chinook Salmon and the Northern spotted owl) were excluded from consideration because their habitats are sufficiently removed from the potential use area that exposure to the alternative herbicides will not occur. A preliminary ecotoxicological risk assessment was conducted to determine the likelihood of adverse impacts upon the remaining three species (Bull trout, Steelhead, and Bald Eagle) due to the use of 31 non-glyphosate herbicides and glyphosate. This risk assessment showed that for fish, 13 herbicides could be eliminated from further consideration due to the low acute toxicity of the herbicide and the lack of chronic exposure. For birds, 26 herbicides can be eliminated from further consideration for the same reason. For fish, twelve herbicides can be eliminated from further consideration due to the estimated environmental concentration (EEC) falling below the level of concern (LOC). For birds, six herbicides can be eliminated from further consideration for the same reason. For fish, the risk assessment showed that certain precautions would ensure that the use of seven herbicides would not adversely impact species of these taxa. No such precautions were found to be required for birds.

Based on this assessment, Compliance Services International concluded there are a number of alternative herbicides that can be used without presenting potential risks to T&E species. There is also a subset of alternative herbicides that, with certain precautions, can also be used without presenting potential risk to T&E species. None of the identified alternatives to glyphosate would need to be eliminated from use should GTCB control be necessary. Consequently, should there be a need to control GTCB, a number of herbicides are available to provide such control without adverse impact on T&E species in the vicinity of the counties assessed.

7. Cumulative effects

NEPA requires agencies to consider the potential cumulative environmental impacts of similar, synergistic, or related additional major federal actions, which, in concert, may in time, contribute to greater environmental impacts than could be caused by the single action that gave rise to the EIS. See 40 CFR § 1508.7. For a summary of potential cumulative impacts of GTCB, see the table in Appendix E. In considering cumulative negative impacts, however, the EIS should also take into account cumulative benefits of these same developments. Just as deregulating GTCB may confer significant benefits, so may the synergistic and cumulative benefits accompany the deregulation of other genetically modified grasses and other species. Changes in the environments into which GTCB might be introduced also may indirectly contribute to a greater environmental impact.

The successful commercialization of GTCB may encourage the development of other biotechnology-derived turf grasses with disease and insect resistance, drought and cold tolerance, and quality traits that result in less mowing and consequently less fuel consumption and small engine air emissions. The commercialization of these products will provide tangible consumer benefits and will enhance the environmental and human health benefits of turfgrasses.

Several of the weeds frequently found on golf courses are also human allergens. For example, the pollen of Johnsongrass, wild carrot, and dandelions is considered highly allergenic (Ogren 1999). These weeds are all susceptible to glyphosate elimination or reduction, which would help reduce their spread to non-play areas on the course, neighboring residences, and other public and private lands. Reducing their establishment in these areas would decrease human exposure to their allergens while contributing to an overall reduction in pesticide use and human exposure.

D. Uncertainty

APHIS may find the following comments of Dr. Norman Borlaug, Nobel Prize winner and father of the Green Revolution particularly pertinent to the scoping of the EIS.

> Although we must be prudent in assessing new technologies, these assessments must not be based on overly conservative or overtly inaccurate assumptions or be swayed by anti-business, anti-establishment, anti-globalization agendas of a few activists, or by the self interest of bureaucrats. They must be based on good science and good sense. It is easy to forget that science offers more than a body of knowledge and a process for adding a new knowledge. It tells us not only the limits of what we know but also what we do not know. It identifies areas of uncertainty and offers an estimate of how great and critical that uncertainty is likely to be.

GTCB does not pose any additional unique or unknown risks beyond those speculated about above, because bentgrasses are native and naturalized in the U.S., have been safely employed for a number of purposes, and have been widely distributed. Any uncertainty about GTCB's environmental impact is remote and speculative, especially since other than tolerance to glyphosate GTCB is not different than nontransgenic bentgrasses, which already have some natural tolerance to the herbicide. Therefore, it is extremely unlikely that the additional glyphosate tolerance conferred by the *epsps* gene will affect the geographic distribution of GTCB. Nor is there any competitive advantage conferred by such tolerance, except where glyphosate may be introduced into the vegetative system. As stated in detail in earlier portions of this comment, if removal is desired, a number of safe and effective herbicides, which have been in general use for a considerable period, are available for GTCB control.

F. Mitigation

CEQ and APHIS guidelines contemplate that mitigation measures may be discussed in EISes to lay a foundation for final agency action under its regulatory authorities. NEPA is a full disclosure statute. It does not confer separate authority upon the agency to regulate applicant behavior. CEQ guidelines specifically contemplate inclusion of "appropriate mitigation measures not already included in the proposed action or alternatives." 40 CFR § 1502.14(f). Such discussion may either occur in the alternatives section of the EIS, or in its discussion of potential environmental consequences. See also 40 CFR § 1502.16(g). The types of measures, which may mitigate environmental impacts, or the risk that such impacts may occur, are set out in 40 CFR § 1508.20, and they are broad.

For example, male sterility has been identified as a potential means to mitigate GTCB gene flow. However, while male sterility offers some promise as a means to reduce the potential for an inadvertent release of fertile pollen, the EIS should consider that a male sterility system would only address one aspect of gene flow—pollen dispersion. Although male sterility has been used with some success in other crops, the same has not been demonstrated with a publicly available system in grasses. For example, to be useful, there must be certainty that all pollen will be sterile and that the sterility mechanism will remain stable after multiple generations of seed production. Such validation can be accomplished only after many years of testing in various locations to ensure the system is reliable and safe to humans and the environment and that undesirable agronomic characteristics such as disease and/or insect susceptibility have not been conferred. Even if the integrity of a male sterility system were validated, it would not address seed scatter or vegetative propagule dispersion, which are the two most probable means of gene flow for grasses. Biotechnological or other mechanisms to accomplish these goals are not currently available for use in grasses.

The EIS should also reiterate that other than tolerance to glyphosate, GTCB is not different from non-transgenic bentgrasses and that a selective advantage is not conferred by this trait unless it is treated with the herbicide. Thus, requiring male sterility or another system to limit GTCB gene flow would incorrectly imply that these natural processes, which have been occurring in a species that (1) is native and prevalent throughout the United States, (2) provides important ecological benefits, (3) is not a noxious weed, and (4) is rarely treated with glyphosate yet easily controlled by numerous non-glyphosate herbicides, represent a significant environmental risk.

Since the Scotts and Monsanto petition asks that APHIS deregulate GTCB, the EIS will need to discuss any mitigation measures that the agency may place under consideration as it proceeds with EIS preparation and consideration of the deregulation petition. The stewardship program identified and committed to by Scotts and Monsanto in the petition is the foundation of an adaptive management strategy to increase the potential for GTCB to be maintained where it is intended (See Petition, p. 272 ff.). Such adaptive management programs are consistent with CEQ guidance and have been incorporated in several EISes prepared by the USFS and BLM. (NEPA Task Force 2003; CEQ 1997).

G. Summary

Scotts and Monsanto have provided comments to APHIS, which we believe are important to establish the appropriate scope of the EIS. An important component of the scoping process is to clearly define the affected environment and establish baseline conditions. Conventional bentgrass and other herbicide-tolerant bentgrasses should be used as comparators for establishing this baseline. We believe that the preliminary risk assessment and full consideration of the issues discussed in this document regarding the affected environment, environmental consequences, and issues regarding uncertainty will result in an EIS that has fully considered the relevant issues. This will allow APHIS to prepare an EIS that fulfills the statutory requirements under NEPA to assess the potential environmental impacts from the decision on the Scotts and Monsanto petition to deregulate glyphosate-tolerant bentgrass.

Appendix A. Non-recreational beneficial uses of bentgrasses in the United States.

Use	References
Roadside stabilization	1) Anonymous. 2002. Grass Seed. In: Standard Specifications for Road and Bridge Construction, State of New Hampshire, Section 644. 2) Anonymous. 2003. 2003 Seeding Manual. Office of Environmental Services, Minnesota Department of Transportation. 3) Anonymous. 1998. Specification T-901. Seeding. In: Standard Specifications for Airport Construction. State of Wisconsin Department of Transportation, Bureau of Aeronautics
Grass filter and/or buffer strips	1) USDA NRCS Illinois. 2002. Delaware Conservation Practice Standard. Filter Strip. Code 393. 2) USDA NRCS Indiana. 2000. Indiana Conservation Practice Standard. Filter Strip. Code 393. 3) USDA NRCS Kentucky. 2002. Kentucky Conservation Practice Standard. Filter Strip. Code 393. 4) USDA NRCS Minnesota. 2002. Minnesota Conservation Practice Standard. Filter Strip. Code 393. 5) USDA NRCS New York. 2004. New York Conservation Practice Standard. Filter Strip. Code 393. 6) USDA NRCS. 2000. Filter Strips. Conservation Reserve Enhancement Program, CREP-CP21. 4 pp. 7) USDA NRCS. 1999. Grassed Waterway with Vegetated Filter, Chapter 3f. In: CORE4 Conservation Practices Training Guide. The Common Sense Approach to Natural Resource Conservation. 395 pp.

Appendix A. Continued.

Use	References
Erosion and sediment control	1) Connecticut Department of Environmental Protection. 2004. 2004 Connecticut Stormwater Quality Manual. 2) Anonymous. 2000. Standard Grass Mixes. City of Kent, Washington. 3) Center for Watershed Protection and Maryland Department of the Environment. 2000. Appendix A, Landscaping Guidance for Stormwater BMPs. In: 2000 Maryland Stormwater Design Manual Volumes I &II. 4) Hubert, M. 2003. 2003 Revision of Maine Erosion and Sediment Control BMP Manual. Division of Watershed Management, Bureau of Land and Water Quality, Maine Department of Environmental Protection. 5) Anonymous. 2003. Dam Safety: Ground Cover. Indiana Department of Natural Resources, Division of Water. 6) Washington State Department of Ecology, Water Quality Program. 2001. Chapter 10 – Wetpool Facilities. In: Stormwater Management Manual for Western Washington. 7) Anonymous. 2002. Appendix A, Site Design and Landscaping Guidance. In: Vermont Stormwater Management Manual, Volume II. 8) Horton, H. 1994. Planting Guide for Utah. Utah State University Extension. Ag- 433. 9) USDA Soil Conservation Service. 1980. A guide to Conservation Plantings on Critical erosion Areas. 31pp. 10) USDA NRCS. 1999. Basic Seed Data Supporting NRCS Vegetative Guides. TN-Plant Materials. CA-5 (Revision 2) 11) Virginia Department of Conservation and Recreation. 1999. Minimum Standard 3.03. Vegetated Emergency Spillway. Virginia Stormwater Management Handbook. First Edition, Volume I. 12) Virginia Department of Conservation and Recreation. 1992. Chapter 3.32. State Minimum Standards and Specifications - Permanent Seeding. Virginia Erosion and Sediment Control Handbook.

Appendix A. Continued.

Use	References
Grassland and pasture forage	1) Monsen, Stephen B.; Stevens, Richard; Shaw, Nancy L., comps. 2004. Restoring Western Ranges and Wildlands. Gen. Tech. Rep. RMRS-GTR-136-vols-1-3. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 2) Weintraub, F. C. 1953. Grasses introduced into the United States. Agric. Handb. 58. Washington, DC: U.S. Department of Agriculture, Forest Service. 79 pp. 3) Balasko, J. A.; Evers, G. W.; Duell, R. W. 1995. Bluegrasses, ryegrasses, and bentgrasses. In: Barnes, R. F.; Miller, D. A.; Nelson, C. J., eds. Forages. 5th ed. Ames: Iowa State University Press: 357–372. 4) Stubbendieck, J.; Jones, T. A. 1996. Other cool-season grasses. In: Moser, L. E.; Buxton, D. R.; Casler, M. D., eds. Cool-season forage grasses. Agronomy No. 34. Madison, WI: American Society of Agronomy, Inc.; Crop Science Society of America, Inc.; Soil Science Society of America, Inc.: 765–780. 5) Archer, S. and C. Bunch. 1953. Grasses. In: The American Grass Book. University of Oklahoma Press: 242–243. 6) Lacey, J. and J. Mosley. 2002. 250 Plants for Range Contests in Montana. Montana State University Extension Service. MT198402 AG 6/2002. 7) Sedivec, Kevin and W. Barker 1998. Selected North Dakota and Minnesota Range Plants. NDSU Department of Animal and Range Sciences, NDSU Extension Service. EB-69. http://www.ext.nodak.edu/extpubs/ansci/range/eb69-6.htm. 8) Fergus, Ernest N.; Buckner, Robert C. 1973. The bluegrasses and redtop. In: Forage sciences--grassland agriculture. [Place of publication unknown]: [Publisher unknown]: 243-253. On file with: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Fire Sciences Laboratory, Missoula, MT. 9) Wheeler, W. A.; Hill, D. D. 1957. Grassland seeds. Princeton, NJ: D. Van Nostrand Company, Inc. 628 pp. 10) Lindstrom, T. 1998. Characteristics of Grasses. In: Forage and Conservation Planting Guide. Sustainable Agriculture Research and Education, Western Region. Compiled by Utah State Interagency Plant materials Committee. http://wsare.usu.edu/plantguy/grasses.htm
Mine reclamation	1) Skousen, J. and C. Zipper. 1996. Reclamation Guidelines for Surface Mined Land in Southwest Virginia. Revegetation Species and Practices. Virginia Cooperative Extension. Publication 460-122. 2) Marty, L. 2000. Development of Acid/Heavy Metal-Tolerant Cultivars (DATC) Project. Clark Fork Symposium, Missoula, MT. April 14 – 15, 2000. 3) Denison, S. and R. Wilkins. 2000. The Practical Guide to Reclamation in Utah. Utah Oil, Gas and Mining. 162 pp.

Appendix A. Continued.

Use	References
Wildlife habitat	1) Kentucky Department of Fish and Wildlife. Cool Season Grasses. http://fw.ky.gov/grasses.asp. 2) Martin, D. 2004. Pasture/ hayland seedings and their suitability for bobwhite quail. Missouri Department of Conservation. http://mdc.mo.gov/landown/grass/bobwhite/ 3) Martin, D. 2004. Pasture/ hayland seedings and their suitability for the prairie chicken. Missouri Department of Conservation. http://mdc.mo.gov/landown/grass/pchicken/ 4) Martin, D. 2004. Pasture/ hayland seedings and their suitability for ring-necked pheasant. Missouri Department of Conservation. http://mdc.mo.gov/landown/grass/pheasant/ 5) Westemeier, R.L. 1973. Prescribed burning in grassland management for prairie chickens in Illinois. In: Proceedings, Annual Tall Timbers Fire Ecology Conference. No. 12, pp 317-341. 6) Esser, Lora L. 1994. *Agrostis stolonifera*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). 7) Carey, Jennifer H. 1995. *Agrostis gigantea*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). 8) Tesky, Julie L. 1993. *Anser albifrons*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). 9) USDA NRCS Indiana. 2002. Indiana Conservation Practice Standard. Upland Wildlife Habitat Management. Code 645.

* Critical Area Planting: Planting vegetation, such as trees, shrubs, vines, grasses, or legumes on highly erodible or critically eroding areas. The practice may be applied for one or more of the following purposes: to reduce soil erosion by wind and water; to improve water quality by reducing off-site sediment movement, to improve wildlife habitat and visual resources. The conditions under which the practice applies include all land uses where soil stabilization requires using specialized plant species and establishment methods, i.e. conservation structures, embankments, cuts, fills, mined areas, roadsides, landfills, spoilbanks, filter strips, and recreation areas.

Appendix B. Compilation of grass herbicides recommended by university extension services for conventional or glyphosate-tolerant crop varieties and other uses (Values = $ cost per acre/per application)[1].

Trade Name	Common Name	Alfalfa	Canola	Corn	Soy	Sugar-beet	Golf course	Turf seed[2]	Non-crop areas
Aatrex	Atrazine			2.80					
Accent	Nicosulfuron			21.15					
Accent Gold	Clopyralid Flumetsulam Nicosulfuron rimsulfuron			24.50					
Arsenal[3]	Imazapyr								13.95
Assure II	Quizalofop	10.15	10.15		10.15	10.15			10.15
Axiom	Flufenacet Metribuzin			12.95	12.95			9.46 to 13.66	
Balance PRO	Isoxaflutole			19.50			19.50		
Basamid	TDTT						1340.00		
Basis Gold	Nicosulfuron Rimsulfuron atrazine			16.80					
Beacon	Primisulfuron			19.75				21.75	
Bicep II Magnum	Atrazine S-metolachlor			26.65					
Boundary	Metribuzin S-metolachlor				28.50				
Callisto	Mesotrione			12.00					

Compilation of grass herbicides (contd.)

Trade Name	Common Name	Alfalfa	Canola	Corn	Soy	Sugar-beet	Golf course	Turf seed[1]	Non-crop areas
Celebrity Plus	Dicamba diflufenzopyr nicosulfuron			23.35					
Define	Flufenacet			25.30					
Direx	Diuron							3.38 to 13.52	25.50
Dual II Magnum	S-metolachlor			26.25	26.25	26.25		12.61	
Envoy Valent	Clethodim					9.25	9.25		9.25
Epic	Flufenacet Isoxaflutole			44.00					
Eptam	EPTC	27.85				27.85			
Exceed Spirit	Prosulfuron Primisulfuron			9.40					
Finale	Glufosinate						82.50		82.50
Fusilade DX	Fluazifop-P	12.65			12.65		45.00	8.56 to 17.11	12.65
Fusion	Fluazifop-P Fenoxaprop				13.60				
Goal	Oxyfluorfen							1.37 to 10.99	90.00
Gramoxone Max	Paraquat	13.50		13.50		13.50		8.14	13.50

Compilation of grass herbicides (contd.)

Trade Name	Common Name	Alfalfa	Canola	Corn	Soy	Sugar-beet	Golf course	Turf seed[2]	Non-crop areas
Glyphosate (aquatic use)[4]	Glyphosate								24.41
Habitat (aquatic use)[3]	Imazapyr								21.00
Kerb	Pronamide							8.55 to 25.65	
Liberty	Glufosinate		16.20	16.20					
Liberty ATZ	Glufosinate Atrazine			18.00					
Lightning	Imazethapyr Imazapyr			14.75			21.00		
Lumax	S-metolachlor atrazine mesotrione			16.50					
Northstar	Primisulfuron Dicamba			9.25					
Nortron SC	Ethofumesate					98.45		19.29	
Option	Foramsulfuron			15.00					
Outlook	S-dimethanamid			23.30	23.30			16.15 to 24.23	
Outrider	Sulfosulfuron								11.50
Pendimax	Pendimethalin	9.10		9.10	9.10				
Poast	Sethoxydim	12.20	12.20		12.20	12.20		13.98 to 24.86	12.20

Compilation of grass herbicides (contd.)

Trade Name	Common Name	Alfalfa	Canola	Corn	Soy	Sugar-beet	Golf course	Turf seed[2]	Non-crop areas
Princep	Simazine			18.00					
Prism	Clethodim	9.25	9.25			9.25			
Prowl	Pendimethalin	9.20		9.20	9.20			13.43 to 20.15	
Raptor	Imazamox	15.95			15.95				
Rely	Glufosinate							19.26 to 23.12	
Rezult	Bentazon Sethoxydim				18.40				
Roundup PRO	Glyphosate						16.88	16.88	
Select	Clethodim	11.55	11.55		11.55	11.55			11.50
Sencor	Metribuzin			13.10				6.34 to 14.41	
Simazine	Simazine			18.00					
Sinbar	Terbacil	128.00						15.85 to 31.70	
Steadfast	Nicosulfuron Rimsulfuron			15.00					
Terr-O-Gas	Methyl bromide						494.00	494.00	
Vapam	Metam sodium						100.00	100.00	
Velpar	Hexazinone	45.00							

Footnotes

[1] References for weed management guides are provided. Herbicide costs compiled from Zollinger (2004), Vandiver and Treadway (2002) and BASF (personal communication).

[2] Range provided as the rate of herbicide used depends on the turf species and the conditions at the time of application (Woodburn Fertilizer. 2004).

[3] Applied at a rate of 0.0625 oz per acre (0.125 lb ae)

[4] Mean cost of generic glyphosate = $65.10 applied at 1.5 lb ae per acre / 4.0 lb ae per gal = (0.375 gal) ($65.10) = $24.41 per application (Vandiver and Treadway (2002).

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Zollinger, R. 2004. 2004 North Dakota Weed Control Guide. W-253, January 2004. North Dakota State University, NDSU Extension Service. http://www.ag.ndsu.nodak.edu/weeds/w253/w253w.htm

Appendix C. 2003 Herbicide application summary for the United States Forest Service and Bureau of Land Management

2003 United States Forest Service Herbicide Summary (http://www.fs.fed.us/foresthealth/pesticide/reports.shtml)

Common Name	Acres Treated	% Total Treated Acres	% Total USFS Acres
2,4-D	44,412.63	21.59%	0.0233%
Bensulide	1.00	0.00%	0.0000%
Bromacil	2.00	0.00%	0.0000%
Chlorsulfuron	1,887.14	0.92%	0.0010%
Clopyralid	8,942.64	4.35%	0.0047%
Dicamba	5,168.08	2.51%	0.0027%
Dimethylamine	1.50	0.00%	0.0000%
Diquat	10.00	0.00%	0.0000%
Diuron/Diuron & Bromacil	27,118.50	13.18%	0.0142%
Fosamine ammonium	434.40	0.21%	0.0002%
Glyphosate	13,200.05	6.42%	0.0069%
Hexazinone	718.00	0.35%	0.0004%
imazapic	3,815.82	1.86%	0.0020%
Imazapyr	6,143.05	2.99%	0.0032%
Imidizole	284.00	0.14%	0.0001%
Metsulfuron-methyl	5,775.70	2.81%	0.0030%
Mineral oil	28.00	0.01%	0.0000%
Oxyfluorfen	155.31	0.08%	0.0001%
Picloram	73,579.18	35.77%	0.0385%
Sethoxydim	2.12	0.00%	0.0000%
Sulfometuron methyl	714.00	0.35%	0.0004%
Triclopyr	13,289.37	6.46%	0.0070%
Total Treated Acres	**205,683**		
Total USFS Acres	**191,000,000**		

2003 Bureau of Land Management Herbicide Summary*

Common Name	Acres Treated	% Total Treated Acres	% Total BLM Acres
Bromacil	627.60	0.58%	0.0002%
Chlorsulfuron	1977.20	1.82%	0.0008%
Clopyralid	8427.68	7.75%	0.0032%
2,4-D	40753.23	37.49%	0.0156%
Dicamba	5605.91	5.16%	0.0021%
Diuron	951.10	0.87%	0.0004%
Foramine	8.00	0.01%	0.0000%
Glyphosate	9437.31	8.68%	0.0036%
Hexazinone	255.00	0.23%	0.0001%
Imazapic	38.26	0.04%	0.0000%
Imazapyr	1317.80	1.21%	0.0005%
Metsulfuron	7579.13	6.97%	0.0029%
Picloram	26947.66	24.79%	0.0103%
Sulfometuron	138.60	0.13%	0.0001%
Tebuthiuron	362.00	0.33%	0.0001%
Triclopyr	4292.23	3.95%	0.0016%
Total Treated Acres	**108,719**		
Total BLM Acres	**261,000,000**		

* Data obtained through the Freedom of Information Act from the Bureau of Land Management

Appendix D. Summary of herbicide efficacy studies for the control of creeping bentgrass

A number of new herbicides studies have been brought to our attention or conducted over the last several months. These studies are individually attached and the results are highlighted in Table 1.

Two studies examined the use of imazapyr for creeping bentgrass control (Virginia Tech., University of Rhode Island). Both studies indicate near complete control of creeping bentgrass with this product. In addition to imazapyr, Virginia Tech has demonstrated control of creeping bentgrass with dazomet, glufosinate and mesotrione. A study carried out by Scott's and Monsanto (Crockett and Frelich) indicate that a rate of 0.087-0.5% v/v imazapyr will control creeping bentgrass. This information was provided to USDA BRS in a letter dated June 28, 2004 (letter was addressed to Gina Ramos, Bureau of Land Management with Drs. Neil Hoffman, Virgil Meier and Bruce MacBryde of USDDA BRS copied).

Research by Marvin Butler of the Central Oregon Experimental Station, Oregon State University is also attached. Fall applied terbacil, diuron + primsulfuron-methly and diuron + oxyfluorfen all provided control of creeping bentgrass, although timing of the application is important. This work also indicates that terbacil can be used on Kentucky bluegrass with only a minor impact on seed yield. Additionally, Prowl and Define resulted in little creeping bentgrass damage and may have potential in creeping bentgrass seed production. A separate study looking at the impact of herbicides and spring tillage indicate that tillage alone is effective in controlling creeping bentgrass.

Finally, another study on bentgrass control was carried out by George Mueller-Warrant of USDA-ARS. This work, which extended over five growing seasons demonstrates that Fusilade DX, Select and Assure II result in similar control values when compared to glyphosate. These results indicate that several post-emergent herbicides other than glyphosate, may be used to effectively control creeping bentgrass.

Table 1. 2004 data compilation for control of creeping bentgrass.				
Product	**Chemical**	**Rate**	**Control Value**	**References**
Arsenal	imazapyr	0.5 –2.0 % v/v	95-100%	Askew, Taylorson
Arsenal	imazapyr	0.0837 – 0.5 % v/v	95-99%	Crockett and Frelich
Basamid	dazomet	350 lb/a	96%	Askew
Finale	glufosinate	3.125% v/v	96%	Askew
Callisto	mesotrione	.025 lb/A	98%	Askew
Sinbar	terbacil	0.5 lb/A	96%	Butler
Diuron + Beacon	diuron + primsulfuron-methyl	3.0 lb/A + 0.38 oz/A	98%	Butler
Diuron + Goal	diuron + oxifluorfen	3.0 lb/A + 12 oz/A	90%	Butler
Fusilasde DX	fluazifop-butyl	0.375 lb ai /A	similar to glyphosate	Mueller-Warrant
Select	clethodim	0.125 lb ai /A	similar to glyphosate	Mueller-Warrant
ASSURE II	quizalofop p-ethyl	0.082 LB AI /A	similar to glyphosate	Mueller-Warrant
Cultural Practices		**Timing**		
Tillage		spring	100%	Butler

Control of Roundup Ready Creeping Bentgrass in Central Oregon Kentucky Bluegrass Seed Production, 2003-2004

Marvin Butler, Jim Carroll, Claudia Campbell

Introduction

The Oregon Department of Agriculture established a control area for the production of Roundup Ready creeping bentgrass seed north of Madras, Oregon. This area east of the Cascade mountain range was chosen because of its isolation from the Willamette Valley. The 50,000 acres of irrigated agriculture in this arid, high desert region are surrounded by sagebrush and juniper and includes Kentucky bluegrass (*Poa pratensis*) and rough bluegrass (*Poa trivialis*) seed production. Commercial plantings of Roundup Ready creeping bentgrass were made within the control area in 2002.

Methods and Materials

Herbicides were evaluated for control of potential creeping bentgrass escapes in Kentucky bluegrass seed fields. Treatments were applied October 6 and November 10, 2003 to plots 10 x 25 ft replicated three times in commercial fields of both Roundup Ready creeping bentgrass and Kentucky bluegrass. Plots were evaluated for control of seedling and established plants in Roudup Ready creeping bentgrass March 26 and June 4, 2004. Kentucky bluegrass was evaluated for phytotoxicity March 26 and reduction in seed set June 4, 2004.

Results and Discussion

Treatments providing from 95 to 100 percent control of creeping bentgrass were a split application of Beacon at 0.38 oz/acre plus diuron at 2.0 lb/acre (95 percent control), Sinbar alone at 0.5 lb/acre (95 percent control), Beacon at 0.38 oz/acre followed by Beacon at 0.38 oz/acre plus Sinbar at 2.0 lb/acre (98 percent control), diuron at 3.0 lb/acre followed by diuron at 3.0 lb/acre plus Beacon at 0.38 oz/acre (98 percent control), and a split application of Beacon at 0.38 oz/acre plus Sinbar at 0.5 lb/acre (100 percent control). Of these, treatments with no visible effect on seed set in Kentucky bluegrass were Beacon followed by Beacon plus Sinbar, and Sinbar alone. Split applications of Beacon plus diuron and Beacon plus Sinbar reduced seed set eight percent, while a split application of Beacon plus Sinbar cause a 42 percent reduction in seed set.

Table 1. Control of Roundup Ready bentgrass, near Madras, Oregon, 2004.

Treatment[1]	Product/acre	Application Timing[2]	% Reduction in Biomass			
			March		June	
Beacon + Sinbar	0.38 oz + 0.5 lb	Oct	98.0	a[3]	100.0	a
Beacon + Sinbar	0.38 oz + 0.5 lb	Nov				
Diuron	3.0 lb	Oct	96.3	a	98.3	a
Diuron + Beacon	3.0 lb + 0.38 oz	Nov				
Beacon	0.38 oz	Oct	88.0	a	98.0	a
Beacon + Sinbar	0.38 oz + 0.5 lb	Nov				
Sinbar	0.5 lb	Nov	60.0	bc	95.7	a
Beacon + Diuron	0.38 + 2.0 lb	Oct	94.7	a	95.3	a
Beacon + Diuron	0.38 oz + 2.0 lb	Nov				
Beacon + Sinbar	0.38 + 0.5 lb	Nov	40.0	cd	90.7	a
Diuron + Goal	2.0 lb + 12 oz	Oct	92.0	a	90.3	a
Beacon	0.38 oz	Oct	78.7	ab	83.3	ab
Beacon + Diuron	0.38 oz + 2.0 lb	Nov				
Diuron	3.0 lb	Nov	50.0	cd	60.0	bc
Goal + Sencor DF	12.0 oz + 0.33 lb	Oct	87.0	a	43.3	cd
Beacon + Diuron	0.38 oz + 2.0 lb	Nov	38.3	cd	36.7	cde
Beacon	0.38 oz	Oct	35.0	d	21.7	def
Beacon	0.38 oz	Nov				
Prowl + Goal	4.0 pt + 12.0 oz	Oct	30.0	de	13.3	ef
Define	9.0 oz	Oct	11.7	ef	1.7	f
Prowl	5.0 pt	Oct	3.3	f	0.7	f
Untreated	----	----	0.0	f	0.0	f

[1]Rivet applied at 1 qt/100 gal with all treatments.
[2]Applications were made on October 6 and November 10, 2003.
[3]Mean separation with Student-Newman-Kuels Test at $P \leq 0.05$.

Table 2. Effect of herbicides for control of Roundup Ready bentgrass on seed set in Kentucky bluegrass, near Madras, Oregon, 2004.

Treatment[1]	Product/acre	Application Timing[2]	Reduction in Seed Set	
			------------%-----------	
Diuron	3.0 lb	Oct	41.66	a[3]
Diuron + Beacon	3.0 lb + 0.38 oz	Nov		
Goal + Sencor DF	12.0 oz + 0.33 lb	Oct	28.33	b
Define	9.0 oz	Oct	25	b
Diuron + Goal	2.0 lb + 12.0 oz	Oct	10	c
Beacon + diuron	0.38 oz + 2.0 lb	Oct	8.33	c
Beacon + diuron	0.38 oz + 2.0 lb	Nov		
Beacon + Sinbar	0.38 oz + 0.5 lb	Oct	8.33	c
Beacon + Sinbar	0.38 oz + 0.5 lb	Nov		
Beacon + Sinbar	0.38 oz + 0.5 lb	Nov	5	c
Beacon	0.38 oz	Oct	0	c
Beacon + diuron	0.38 oz + 2.0 lb	Nov		
Beacon	0.38 oz	Oct	0	c
Beacon	0.38 oz	Nov		
Prowl + Goal	4.0 pts + 12.0 oz	Oct	0	c
Prowl	5.0 pts	Oct	0	c
Beacon	0.38 oz	Oct	0	c
Beacon + Sinbar	0.38 oz +0.5 lb	Nov		
Diuron	3.0 lb	Nov	0	c
Sinbar	0.5 lb	Nov	0	c
Beacon + Diuron	0.38 oz + 2.0 lb	Nov	0	c
Untreated	----	----	0	c

[1]Rivet applied at 1 qt/100 gal with all treatments.
[2]Applications were made on October 6 and November 10, 2003.
[3]Mean separation with Student-Newman-Kuels Test at $P \leq 0.05$.

Use of Herbicides and Tillage to Remove Commercial Plantings of Roundup Ready Creeping Bentgrass in Central Oregon , 2004

Marvin Butler, Ron Crockett, Claudia Campbell, Lou Fine

Introduction

The Oregon Department of Agriculture established a control area for the production of Roundup Ready creeping bentgrass seed north of Madras, Oregon. This area east of the Cascade mountain range was chosen because of its isolation from the Willamette Valley. The 50,000 acres of irrigated agriculture in this arid, high desert region are surrounded by sagebrush and juniper and includes Kentucky bluegrass (*Poa pratensis*) and rough bluegrass (*Poa trivialis*) seed production. Commercial plantings of Roundup Ready creeping bentgrass were made within the control area in 2002.

Methods and Materials

Herbicide plus tillage treatments were evaluated for removal of commercial plantings of creeping bentgrass plantings. Treatments were applied May 7, 2004 to plots 10 x 55 ft replicated four times in a commercial field of Roundup Ready creeping bentgrass. Plots were evaluated for control of Roundup Ready creeping bentgrass June 24 prior to double disking across the plots down the length of the evaluation. This was followed by a re-evaluation of the plots September 3. The plots were rotovated and will be observed through the fall and spring for any new growth that may occur.

Results and Discussion

Treatments of Select II and Select II plus Arsenal provided 73and 71 percent control of Roundup Ready creeping bentgrass, significantly greater than other treatments. This was followed by Fusilade with 65 percent control. Treatments that included Beacon provided no observable control. After disking there was 100 percent control of creeping bentgrass, including plots that did not receive an herbicide treatment. The final column in Table one indicates of percent of plants not dislodged during the initial disking operation. Plots will be observed following precipitation this fall and winter for evidence of regrowth. Alternative trade names for Select II are Envoy and Prism, an alternate name for Rely is Finale, and Arsenal is Habitat.

Table 1. Herbicide and tillage control on Roundup Ready bentgrass, near Madras, Oregon, 2004.

Treatment	Product/a	Herbicide control	Herbicide + tillage control	Plants not dislodged
		------%------	---%---	------%------
Select II	34 fl oz	72.9 a[1]	100	1.5 cd
+COC	1.0 % v/v			
Arsenal	4 fl oz	71.0 a	100	1.0 d
+Select II	34 fl oz			
+COC	1.0 % v/v			
Fusilade	24 fl oz	64.5 b	100	1.3 d
+COC	1.0 % v/v			
Beacon	0.38 oz	60.9 b	100	2.8 bcd
+Select II	34 fl oz			
+NIS	0.25 % v/v			
Assure II	16 fl oz	60.9 b	100	3.8 abc
+COC	1.0 % v/v			
Arsenal	4 fl oz	60.0 b	100	1.3 d
+Sinbar	0.5 lb			
+NIS	0.25 % v/v			
Poast	32 fl oz	41.9 c	100	1.5 cd
+Sinbar	0.5 lb			
+COC	1.0 % v/v			
Rely	6 qt	13.8 d	100	1.0 d
+Sinbar	0.5 lb			
+NIS	0.25 % v/v			
Beacon	0.38 oz	0.0 e	100	6.0 a
+Harness	37 oz			
+NIS	0.25 % v/v			
Beacon	0.38 oz	0.0 e	100	2.3 cd
+Sinbar	0.5 lb			
+NIS	0.25 % v/v			
Beacon	0.38 oz	0.0 e	100	2.3 cd
+Diuron	2.0 lb			
+NIS	0.25 % v/v			
Beacon	0.76 oz	0.0 e	100	2.5 cd
+NIS	0.25 % v/v			
Untreated	----	0.0 e	100	5.0 ab
			NS	

[1]Mean separation with Student-Newman-Kuels Test at $P \leq 0.05$.

Response of Space-Planted Bentgrass to Grass-Control Herbicides

G.W. Mueller-Warrant

National Forage Seed Production Research Center - USDA-ARS

Four hundred acres of Roundup-Ready creeping bentgrass are currently under production in a control district north of Madras, Oregon. Concerns voiced by the grass seed industry during discussions leading to the creation of this control district included anticipated difficulty in removing old stands, controlling volunteer seedlings, limiting movement of pollen, seed, and vegetative propagules, detecting outcrosses, and controlling bentgrass plants containing the Roundup resistance gene whenever and wherever they might appear. Many plans are under development for meeting these concerns, evaluating the consequences of failure to contain this gene, or predicting the likelihood of such failure. One key aspect of informed discussion and decision-making on these topics is knowledge of weed control problems currently posed to the grass seed industry by non-transgenic bentgrass. While many details on the biology, distribution, and control of bentgrass might provide valuable knowledge, the image of an individual, well-established bentgrass plant recovering from a spot-spray herbicide treatment applied explicitly for its control is helpful in defining the most urgently needed research. The isolated plant is primarily competing against other species rather than against itself, it is undergoing rapid vegetative spread, it is hidden from easy detection, and regrowth by a single node or tiller can threaten to reestablish an entire clump following herbicide treatment. Knowledge of the performance of Roundup and alternative herbicides against space-planted bentgrass plants is critically needed, especially on the question of whether or not the plant recovers from injury.

The primary objective of this research was to identify effective herbicide treatments for suppression/control of well-established bentgrass plants, and determine the number of sequential applications of each of these treatments required to achieve lasting control (i.e., no further regrowth). A secondary objective was to quantify possible differences among common bentgrass species in number of herbicide applications required to achieve lasting control of initially well-established plants. Due to concerns over possible escape of herbicide resistance, none of the resistant types developed through genetic engineering or conventional breeding were included in these trials.

Three cycles of tests are being conducted. The first test cycle commenced with transplanting five bentgrass species (dryland, redtop, Colonial, creeping, and velvet) in January 2000 into an old orchardgrass stand, followed by initiation of herbicide treatments in two timing sequences in October and November 2000. The first application in the early timing sequence was made soon after the initiation of vigorous fall regrowth, and treatments were reapplied in early spring and again in early summer after plants had recovered from herbicide damage and initiated new tiller growth. Treatments in the later timing sequence were applied approximately one month after those in the early sequence. The eight herbicide treatments were Roundup 1.5 lb a.i./a, Rely 1.0 lb a.i./a, Gramoxone 0.625 lb a.i./a, Fusilade DX 0.375 lb a.i./a, Kerb 0.375 lb a.i./a (rate increased to 1.0 lb a.i./a for all subsequent applications), Select 0.125 lb a.i./a, Raptor 0.039 lb a.i./a, and a tank-mix of Roundup 1.5 lb a.i./a plus Fusilade DX 0.375 lb a.i./a. Treatments were initially applied to all plots, and subsequently reapplied only to those plots in which surviving bentgrass plants were found. All herbicides achieved fair to good initial "burndown" of bentgrass except for Kerb. The second test cycle commenced with transplanting seven bentgrass species or varieties (Seaside creeping, Penncross 'F1' creeping, SRX7100 Colonial, dryland, velvet, redtop, and a not-yet-identified weedy species collected from a perennial ryegrass field on OR Hwy. 34) in January 2001 into an old orchardgrass stand, followed by initiation of herbicide treatments in two timing sequences in November and December 2001. The ten herbicide treatments in the second cycle included all eight treatments from the first cycle plus Assure II at 0.0825 lb a.i./a and a tank-mix of Roundup at 1.5 lb a.i./a plus Assure II at 0.0825 lb a.i./a. The third test cycle commenced after transplanting seven bentgrass species or varieties (repeating those used in the second test cycle) in late fall 2001 into an old perennial ryegrass stand, followed by initiation of herbicide treatments in October and November 2002. Herbicide treatments used in the second cycle were repeated in the third.

Data being collected includes monthly to bimonthly observations of whether regrowth occurred on each individual plant. Regrowth status was rated into one of four categories: Dead = no signs of any new growth or survival of treated shoots; Unclear = any regrowth present too small to identify, or some treated shoots injured but tissue not quite dead; Alive = one or more healthy tillers present, but tillers smaller in size and fewer in number than before treatment; Robust = many tillers present, plant nearing pre-treatment size. Repeat herbicide applications were generally not made until none of the plants fell into the unclear response category. Individual plots are being retreated until all bentgrass plants present in them have been killed. Primary result of the research is information on the number of times each of the herbicide treatments in the early and later timing sequence (16 treatments in cycle one, 20 in cycles two and three) must be applied in order to kill the bentgrass plants.

None of the treatments in the first, second, or third testing cycle succeeded in completely destroying space-planted, well-established bentgrass plants in a single application. Indeed, some individual bentgrass plants have survived up to seven applications of the least successful treatments in the first cycle. The most effective treatment was a tank-mix of 1.5 lb a.i./a Roundup plus 0.375 lb a.i./a Fusilade, requiring an average of 2.3 applications to kill all bentgrass for the early timing sequence and 2.1 applications for the later timing sequence in the first cycle, while 1.4 and 1.5 applications appear, at the present, to have been sufficient in the second cycle. Fusilade by itself was almost as effective as this tank-mix in the first cycle (requiring an average of 2.35 applications), while Roundup by itself required an average of 0.5 more applications per plant to kill bentgrass than the Roundup plus Fusilade tank-mix. Select at 0.125 lb a.i./a was the next most effective treatment, requiring an average of 3.1 applications to kill bentgrass in the first cycle. In decreasing order of effectiveness, Rely at 1.0 lb a.i./a required an average of 3.35 applications to kill bentgrass, Gramoxone at 0.625 lb a.i./a required 3.77 applications, Raptor at 0.039 lb a.i./a required 3.97 applications, while Kerb has required 6.3 applications to date, with some bentgrass plants still alive. The later timing sequence of the first cycle was more effective than the earlier timing, requiring an average of 0.42 fewer applications to kill all bentgrass. Much of the difference between the two timing sequences has been the result of conditions during the fall applications. Rains arrived relatively late in the falls of both 2000 and 2002, and although herbicide applications for the early timing sequence were delayed until new shoot growth was visible, it is likely that additional tillers arose from dormant buds during the month between the early and late application timings.

Many of treatments in the first cycle had appeared to achieve complete control by spring or summer of 2002, and no bentgrass regrowth could be found in fall 2002 except for some of the Raptor plots, most of the Kerb plots, and a very few plots of the other herbicides. By April 2003, however, bentgrass was once again present in a surprisingly large number of plots. Some of these bentgrass plants were clearly seedlings that had emerged at random locations throughout the plots, and herbicide treatments in spring 2003 to control any obvious seedlings were not included in the total count of applications required to kill the original plants.

Many of the bentgrass plants found in April 2003, however, were growing at or very near to the original planting sites and were larger in size than the obvious seedlings. A likely source for many of these plants would be vegetative propagules from the original plants scattered by a rotary mowing conducted in late summer. Attempts will be made in future years to control seedlings in the third and later years of each cycle with early fall broadcast applications of Prowl and/or Axiom combined with physical shielding of any surviving bentgrass plants remaining from the original planting. Using the same application timing sequences for all herbicide treatments may have worked to the disadvantage of the less effective, contact herbicides (Rely and Gramoxone) because bentgrass regrowth tended to be initiated sooner in these treatments than in the more effective, systemic herbicides (Roundup, Fusilade, Select, and Assure). Bentgrass plants initiating regrowth earlier were more likely to recover to Robust growth status by time of the next application, and hence were much less likely to die from that next herbicide application.

There were interesting differences among the bentgrass species in their probability of recovering from herbicide treatment. In the first cycle, dryland bentgrass and redtop were harder to kill, requiring an average of 0.5 more applications than Colonial and creeping bentgrass. In the second cycle, dryland bentgrass and redtop were once again the hardiest types, requiring an average of 3.3 treatments, whereas creeping, Colonial, and velvet bentgrass only needed an average of 2.1 applications. The not-yet-identified type from Hwy 34 perennial ryegrass was intermediate, requiring an average of 2.7 applications. Treatment of all three cycles will continue until no surviving bentgrass plants are present for all herbicides, or until no further progress is achieved by additional applications of Kerb while all other herbicides have eliminated bentgrass.

Table 1. Third-year results from first cycle bentgrass control study, spring 2003.

Sequence start date[†]	Herbicide trade name	Rate	Bentgrass status before 2nd application (Mar/Apr 2001)			Bentgrass status before 8th application (Mar/Apr 2003)			Total number of times each plant treated to present date
			Robust	***Alive***	***Dead***	***Robust***	***Alive***	***Dead***	
		(lb a.i./a)	----------- (% of plants in each category) -----------						(applications)
Oct 2000	Roundup	1.5	0	90	10	0	40	60	2.95
Nov 2000	Roundup	1.5	0	60	40	0	55	45	2.45
Oct 2000	Rely	1.0	65	30	5	0	45	55	4.00
Nov 2000	Rely	1.0	35	65	0	0	40	60	2.70
Oct 2000	Gramoxone Extra	0.625	45	50	5	0	55	45	3.95
Nov 2000	Gramoxone Extra	0.625	10	80	10	0	30	70	3.60
Oct 2000	Fusilade DX	0.375	0	95	5	0	20	80	2.45
Nov 2000	Fusilade DX	0.375	0	65	35	0	5	95	2.25
Oct 2000	Kerb	0.375 * ->1*	95	5	0	30	40	30	6.45
Nov 2000	Kerb	0.375 * ->1*	80	15	5	10	45	45	6.15
Oct 2000	Select	0.125	0	95	5	0	50	50	3.15
Nov 2000	Select	0.125	0	80	20	0	55	45	3.05
Oct 2000	Raptor	0.039	50	45	5	0	40	60	4.20
Nov 2000	Raptor	0.039	45	45	10	0	35	65	3.75
Oct 2000	Roundup + Fusilade	1.5 + 0.375	0	95	5	0	15	85	2.30
Nov 2000	Roundup + Fusilade	1.5 + 0.375	0	45	55	0	50	50	2.10

Species means avg. over herbicides	No. plants							
Dryland bentgrass	154	26	60	14	2	40	58	3.62
Redtop	84	21	73	6	0	42	58	3.56
Colonial bentgrass	37	27	54	19	0	38	62	3.11
Creeping bentgrass	30	17	66	17	0	40	60	3.07
Velvet bentgrass	2	0	100	0	0	50	50	3.50
Unidentified spp.	13	23	54	23	0	38	62	3.00
Timing means avg. over herbicides								
Early application sequence	---	32	63	5	1	41	58	3.68
Late application sequence	---	16	63	21	1	40	59	3.26

*Kerb applied at 0.375 lb a.i./a in first application of both timing sequences. Rate was then increased to 1.0 lb a.i./a for all subsequent applications.

† Early sequence: Oct. 26, 2000; Mar. 20, 2001; June 12, 2001; Nov. 6, 2001; Apr. 2, 2002; June 14, 2002; Oct. 29, 2002; Mar. 24, 2003. Late sequence: Nov. 17, 2000; Apr. 19, 2001; July 10; Dec. 21, 2001; Apr. 30, 2002; July 19, 2002; Nov. 26, 2002; Apr. 25, 2003. Treatments only reapplied to plots with live bentgrass present. Bentgrass species included dryland, redtop, Colonial, creeping, velvet and unidentified.

Table 2. Second-year results from second cycle bentgrass control study, spring 2003.

Sequence start date[†]	Herbicide trade name	Rate	Bentgrass status before 2nd application (Mar/Apr 2002)			Bentgrass status before 5th application (Mar/Apr 2003)			Total number of times each plant treated to present date
			Robust	***Alive***	***Dead***	***Robust***	***Alive***	***Dead***	
		(lb a.i./a)	----------- (% of plants in each category) -----------						(applications)
Oct 2001	Roundup	1.5	0	32	68	0	7	93	1.96
Nov 2001	Roundup	1.5	7	72	21	0	64	36	2.50
Oct 2001	Rely	1.0	39	57	4	18	39	43	3.61
Nov 2001	Rely	1.0	33	67	0	0	44	56	2.63
Oct 2001	Gramoxone Extra	0.625	33	48	19	4	11	85	3.00
Nov 2001	Gramoxone Extra	0.625	43	53	4	4	21	75	3.04
Oct 2001	Fusilade DX	0.375	4	66	30	0	7	93	2.04
Nov 2001	Fusilade DX	0.375	0	61	39	0	7	93	1.79
Oct 2001	Kerb	1.0	39	61	0	32	25	43	4.07
Nov 2001	Kerb	1.0	25	68	7	29	36	35	4.14
Oct 2001	Select	0.125	4	50	46	0	21	79	2.61
Nov 2001	Select	0.125	0	71	29	0	14	86	2.25
Oct 2001	Raptor	0.039	25	54	21	14	25	61	3.11
Nov 2001	Raptor	0.039	54	46	0	11	7	82	2.61
Oct 2001	Roundup + Fusilade	1.5 + 0.375	0	18	82	0	7	93	1.37
Nov 2001	Roundup + Fusilade	1.5 + 0.375	0	39	61	0	7	93	1.46
Oct 2001	Assure II	0.082	4	73	23	0	12	88	2.81

Nov 2001	Assure II	0.082	7	67	26	0	11	89	2.22
Oct 2001	Roundup + Assure II	1.5 + 0.082	0	39	61	0	11	89	1.57
Nov 2001	Roundup + Assure II	1.5 + 0.082	0	4	96	0	8	92	1.65
Species means avg. over herbicides		No. plants							
	Unidentified Hwy 34 grass seed	80	16	42	42	7	23	70	2.69
	Seaside creeping bentgrass	79	6	45	49	0	13	87	2.14
	Penncross 'F1' creeping bent.	77	17	38	45	0	14	86	2.25
	Colonial bentgrass	77	7	39	54	0	9	91	2.03
	Dryland bentgrass	80	20	51	29	17	22	60	3.31
	Velvet bentgrass	78	9	35	56	0	10	90	1.95
	Redtop	80	18	52	30	9	30	61	3.28
Timing means avg. over herbicides									
	Early application sequence	---	15	50	35	7	17	76	2.62
	Late application sequence	---	3	43	54	3	11	86	2.43

† Early sequence: Nov. 6, 2001; Apr. 2, 2002; June 14, 2002; Oct. 29, 2002; Mar. 24, 2003. Late sequence: Dec. 21, 2001; Apr. 30, 2002; July 19, 2002; Nov. 26, 2002; Apr. 25, 2003. Treatments only reapplied to plots with live bentgrass present. Bentgrass species included unidentified weedy type from Hwy 34 perennial ryegrass field, Seaside creeping, Penncross 'F1' creeping, Colonial, dryland, velvet, and redtop.

2001 SEED PRODUCTION RESEARCH AT

OREGON STATE UNIVERSITY

USDA-ARS COOPERATING

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Hyslop Field Day Spring 2004 Handout

Table 1. Fourth-year results from first cycle bentgrass control study, spring 2004 (BENTKILL).

Trt. no.	Sequence start date†	Herbicide Trade name	Rate	Bentgrass status before 2nd application (Mar/Apr 2001) Robust	Alive	Dead	Bentgrass status before 11th application (Mar/Apr 2004) Robust	Alive	Dead	Total number of times each plant treated to present date
			lb a.i./A	(% of plants in each category)						(applications)
1	Oct 2000	Roundup	1.5	0	90	10	0	0	100	3.05
2	Nov 2000	Roundup	1.5	0	60	40	0	0	100	2.60
3	Oct 2000	Rely	1.0	65	30	5	5	25	70	5.00
4	Nov 2000	Rely	1.0	35	65	0	0	30	70	3.65
5	Oct 2000	Gramoxone Extra	0.625	45	50	5	0	20	80	4.95
6	Nov 2000	Gramoxone Extra	0.625	10	80	10	5	35	60	4.65
7	Oct 2000	Fusilade DX	0.375	0	95	5	0	0	100	2.55
8	Nov 2000	Fusilade DX	0.375	0	65	35	0	15	85	2.75
9	Oct 2000	Kerb	0.375* ->1*	95	5	0	35	30	35	8.50
10	Nov 2000	Kerb	0.375* ->1*	80	15	5	20	30	50	7.70
11	Oct 2000	Select	0.125	0	95	5	0	5	95	3.35
12	Nov 2000	Select	0.125	0	80	20	0	10	90	3.55
13	Oct 2000	Raptor	0.039	50	45	5	0	40	60	5.55
14	Nov 2000	Raptor	0.039	45	45	10	10	45	45	5.30
15	Oct 2000	Roundup + Fusilade	1.5 + 0.375	0	95	5	0	0	100	2.35
16	Nov 2000	Roundup + Fusilade	1.5 + 0.375	0	45	55	0	0	100	2.15
Species means avg. over herbicides			No. plants							
Dryland bentgrass			154	26	60	14	4	19	77	4.42
Redtop			84	21	73	6	2	15	83	4.25
Colonial bentgrass			37	27	54	19	3	13	84	3.89
Creeping bentgrass			30	17	66	17	0	10	90	3.50
Velvet bentgrass			2	0	100	0	0	0	100	3.50
Unidentified spp.			13	23	54	23	0	8	92	3.54
Timing means avg. over herbicides										
Early application sequence			---	32	63	5	1	41	58	4.41
Late application sequence			---	16	63	21	1	40	59	3.97

*Kerb applied at 0.375 lbs/A in first application of both timing sequences. Rate was then increased to 1.0 lbs/A for all subsequent applications.

†Early sequence: Oct. 26, 2000; Mar. 20, 2001; June 12, 2001; Nov. 6, 2001; Apr. 2, 2002; June 14, 2002; Oct. 29, 2002; Mar. 24, 2003; June 17, 2003; Nov. 4, 2003; Apr. 3, 2004.

Late sequence: Nov. 17, 2000; Apr. 19, 2001; July 10; Dec. 21, 2001; Apr. 30, 2002; July 19, 2002; Nov. 26, 2002; Apr. 25, 2003; July 25, 2003; Dec. 11, 2003; Apr. 26, 2004.

Treatments only reapplied to plots with live bentgrass present. Bentgrass species included dryland, redtop, Colonial, creeping, velvet and unidentified. Application count includes plots needing spring 2004 treatment.

Table 2. Third-year results from second cycle bentgrass control study, spring 2004 (BENT2002).

Trt. no.	Sequence start date†	Herbicide Trade name	Rate	Bentgrass status before 2nd application (Mar/Apr 2002) *Robust*	*Alive*	*Dead*	Bentgrass status before 8th application (Mar/Apr 2004) *Robust*	*Alive*	*Dead*	Total number of times each plant treated to present date
			lb a.i./A	(% of plants in each category)						(applications)
1	Oct 2001	Roundup	1.5	0	32	68	0	0	100	2.32
2	Nov 2001	Roundup	1.5	7	72	21	0	0	100	3.04
3	Oct 2001	Rely	1.0	39	57	4	11	32	57	4.75
4	Nov 2001	Rely	1.0	33	67	0	0	15	85	3.29
5	Oct 2001	Gramoxone Extra	0.625	33	48	19	0	18	82	3.46
6	Nov 2001	Gramoxone Extra	0.625	43	53	4	7	14	79	3.68
7	Oct 2001	Fusilade DX	0.375	4	66	30	0	0	100	1.96
8	Nov 2001	Fusilade DX	0.375	0	61	39	0	0	100	1.79
9	Oct 2001	Kerb	1.0	39	61	0	25	25	50	5.32
10	Nov 2001	Kerb	1.0	25	68	7	25	29	46	5.79
11	Oct 2001	Select	0.125	4	50	46	0	0	100	2.61
12	Nov 2001	Select	0.125	0	71	29	0	4	96	2.39
13	Oct 2001	Raptor	0.039	25	54	21	7	18	75	3.96
14	Nov 2001	Raptor	0.039	54	46	0	11	10	79	3.18
15	Oct 2001	Roundup + Fusilade	1.5 + 0.375	0	18	82	0	0	100	1.32
16	Nov 2001	Roundup + Fusilade	1.5 + 0.375	0	39	61	0	0	100	1.46
17	Oct 2001	Assure II	0.082	4	73	23	0	0	100	2.61
18	Nov 2001	Assure II	0.082	7	67	26	0	0	100	2.29
19	Oct 2001	Roundup + Assure II	1.5 + 0.082	0	39	61	0	0	100	1.57
20	Nov 2001	Roundup + Assure II	1.5 + 0.082	0	4	96	0	0	100	1.54
Species means avg. over herbicides			No. plants							
		Unidentified Hwy 34 grass seed	80	16	42	42	8	11	81	3.31
		Seaside creeping bentgrass	79	6	45	49	0	5	95	2.33
		Penncross 'F1' creeping bent.	77	17	38	45	0	7	93	2.45
		Colonial bentgrass	77	7	39	54	0	1	99	2.05
		Dryland bentgrass	80	20	51	29	14	16	70	4.25
		Velvet bentgrass	78	9	35	56	0	1	99	2.00
		Redtop	80	18	52	30	9	18	73	4.03
Timing means avg. over herbicides										
		Early application sequence	---	15	50	35	4	10	86	2.99
		Late application sequence	---	3	43	54	3	8	89	2.84

†Early sequence: Nov. 6, 2001; Apr. 2, 2002; June 14, 2002; Oct. 29, 2002; Mar. 24, 2003; June 17, 2003; Nov. 4, 2003; Apr. 3, 2004. Late sequence: Dec. 21, 2001; Apr. 30, 2002; July 19, 2002; Nov. 26, 2002; Apr. 25, 2003; July 25, 2003; Dec. 11, 2003; Apr. 26, 2004. Treatments only reapplied to plots with live bentgrass present. Bentgrass species included unidentified weedy type from Hwy 34 perennial ryegrass field, Seaside creeping, Penncross 'F1' creeping, Colonial, dryland, velvet, and redtop. Application count includes plots needing spring 2004 treatment.

Table 3. Second-year results from third cycle bentgrass control study, spring 2004 (BENT2003).

Trt. no.	Sequence start date†	Herbicide Trade name	Rate	Bentgrass status before 2nd application (Mar/Apr 2003) *Robust*	*Alive*	*Dead*	Bentgrass status before 5th application (Mar/Apr 2004) *Robust*	*Alive*	*Dead*	Total number of times each plant treated to present date
			lb a.i./A	(% of plants in each category)						(applications)
1	Oct 2002	Roundup	1.5	0	46	54	0	0	100	2.07
2	Nov 2002	Roundup	1.5	0	25	75	0	0	100	1.36
3	Oct 2002	Rely	1.0	31	61	8	4	50	46	3.06
4	Nov 2002	Rely	1.0	30	59	11	4	29	67	3.00
5	Oct 2002	Gramoxone Extra	0.625	36	53	11	11	32	57	3.18
6	Nov 2002	Gramoxone Extra	0.625	54	28	18	32	18	50	3.64
7	Oct 2002	Fusilade DX	0.375	4	71	25	0	4	96	1.85
8	Nov 2002	Fusilade DX	0.375	0	63	37	0	4	96	1.68
9	Oct 2002	Kerb	1.0	48	41	11	30	22	48	3.57
10	Nov 2002	Kerb	1.0	11	78	11	18	36	46	3.61
11	Oct 2002	Select	0.125	19	70	11	0	11	89	2.25
12	Nov 2002	Select	0.125	4	63	33	0	0	100	1.71
13	Oct 2002	Raptor	0.039	56	33	11	4	40	56	3.07
14	Nov 2002	Raptor	0.039	81	19	0	22	37	41	3.93
15	Oct 2002	Roundup + Fusilade	1.5 + 0.375	0	43	57	0	0	100	1.41
16	Nov 2002	Roundup + Fusilade	1.5 + 0.375	0	21	79	0	0	100	1.32
17	Oct 2002	Assure II	0.082	7	82	11	0	7	93	2.08
18	Nov 2002	Assure II	0.082	0	71	29	0	4	96	1.93
19	Oct 2002	Roundup + Assure II	1.5 + 0.082	0	75	25	0	0	100	1.79
20	Nov 2002	Roundup + Assure II	1.5 + 0.082	0	30	70	0	0	100	1.27
Species means avg. over herbicides			No. plants							
		Unidentified Hwy 34 grass seed	79	21	58	21	8	29	64	2.95
		Seaside creeping bentgrass	80	11	43	46	0	13	87	2.21
		Penncross 'F1' creeping bent.	77	10	40	50	1	12	87	1.98
		Colonial bentgrass	76	6	44	50	0	8	92	1.78
		Dryland bentgrass	80	28	51	21	15	18	68	3.04
		Velvet bentgrass	77	1	48	51	0	5	95	1.74
		Redtop	79	28	47	25	19	18	63	2.98
Timing means avg. over herbicides										
		Early application sequence	---	20	58	22	5	16	79	2.43
		Late application sequence	---	11	37	52	5	15	80	2.34

†Early sequence: Nov. 6, 2001; Apr. 2, 2002; June 14, 2002; Oct. 29, 2002; Mar. 24, 2003; June 17, 2003; Nov. 4, 2003; Apr. 3, 2004. Late sequence: Dec. 21, 2001; Apr. 30, 2002; July 19, 2002; Nov. 26, 2002; Apr. 25, 2003; July 25, 2003; Dec. 11, 2003; Apr. 26, 2004. Treatments only reapplied to plots with live bentgrass present. Bentgrass species included unidentified weedy type from Hwy 34 perennial ryegrass field, Seaside creeping, Penncross 'F1' creeping, Colonial, dryland, velvet, and redtop. Application count includes plots needing spring 2004 treatment.

Appendix E. Oregon Seed Certification Service - Certification production and quality, top 5 contaminants noted by crop and their occurrence (2000 - 2003)*

2000 Crop	Number tested	Prevalent Contaminant Seeds and Percentage of Samples									
		1st		2nd		3rd		4th		5th	
Tall fescue	2736	Ryegrass	39%	Annual bluegrass	8%	Orchardgrass	4%	Downy brome	3%	Curly dock	3%
Perennial ryegrass	3105	Annual ryegrass	63%	Annual bluegrass	9%	Rattail fescue	7%	Downy brome	4%	Fine fescue	2%
Kentucky bluegrass	338	Witchgrass	7%	Henbit	6%	Canada bluegrass	6%	Rattail fescue	5%	Rough bluegrass	5%
Chewings fescue	334	Rattail fescue	39%	Annual bluegrass	7%	Ryegrass	6%	Downy brome	3%	Field chamomile	2%
Orchardgrass	217	Ryegrass	55%	Annual bluegrass	35%	Tall fescue	30%	Curly dock	13%	Rough bluegrass	13%
Red fescue	199	Rattail fescue	43%	Downy brome	17%	Ryegrass	8%	Annual bluegrass	6%	Kentucky bluegrass	4%
Wheat	47	Oat	2%	Ryegrass	2%	Red wheat	2%	Wild radish	2%	not applicable	
Creeping bentgrass	377	Annual bluegrass	4%	Colonial bentgrass	2%	Kentucky bluegrass	2%	Western yellowcress	2%	Wild carrot	1%
Rough bluegrass	149	Kentucky bluegrass	37%	Windgrass	19%	Rattail fescue	18%	Henbit	6%	Foxtail	5%
Hard fescue	168	Rattail fescue	56%	Ryegrass	16%	Annual bluegrass	10%	Downy brome	4%	Kentucky bluegrass	2%
Annual ryegrass	160	Perennial ryegrass	31%	Annual bluegrass	16%	Rattail fescue	6%	Foxtail	2%	Ladysthumb	2%
Colonial bentgrass	161	Velvetgrass	31%	Foxtail	18%	Toad rush	18%	Annual bluegrass	13%	Silver hairgrass	13%
Alfalfa	3	--	--	--	--	--	--	--	--	--	--
Barley	4	--	--	--	--	--	--	--	--	--	--

Prevalent Contaminants in Seed Crops (2000 – 2003 contd.)

2001	Number tested	Prevalent Contaminant Seeds and Percentage of Samples									
		1st		2nd		3rd		4th		5th	
Tall fescue	2812	Ryegrass	28%	Annual bluegrass	4%	Orchardgrass	3%	Downy brome	3%	Bedstraw	2%
Perennial ryegrass	2097	Annual ryegrass	65%	Annual bluegrass	7%	Rattail fescue	6%	Tall fescue	2%	Downy brome	2%
Kentucky bluegrass	320	Rough bluegrass	8%	Rattail fescue	5%	Lemmons alkaligrass	4%	Witchgrass	4%	Annual bluegrass	4%
Chewings fescue	144	Rattail fescue	31%	Ryegrass	5%	Annual bluegrass	3%	Downy brome	2%	Sedge	1%
Red fescue	93	Rattail fescue	46%	Downy brome	22%	Annual bluegrass	4%	Field pennycress	4%	Henbit	3%
Orchardgrass	144	Ryegrass	53%	Tall fescue	31%	Annual bluegrass	24%	Wild carrot	6%	Curly dock	6%
Wheat	30	Red wheat	17%	Downy brome	3%	Brassica sp.	3%	Shepherdspurse	3%	Kentucky bluegrass	3%
Hard fescue	98	Rattail fescue	48%	Ryegrass	6%	Downy brome	4%	Annual bluegrass	3%	Sedge	2%
Creeping bentgrass	98	Annual bluegrass	2%	Bedstraw	1%	Wild carrot	1%	Common plantain	1%	Sticky mouse-ear	1%
Rough bluegrass	85	Kentucky bluegrass	25%	Rattail fescue	15%	Windgrass	14%	Henbit	6%	Downy brome	6%
Colonial bentgrass	81	Sticky mouse-ear	26%	Velvetgrass	23%	Toad rush	15%	Rough bluegrass	15%	Silver hairgrass	10%
Annual ryegrass	106	Perennial ryegrass	32%	Burr chervil	7%	Annual bluegrass	5%	Foxtail	4%	Wild oat	3%

Prevalent Contaminants in Seed Crops (2000 – 2003 contd.)

2002	Number tested	Prevalent Contaminant Seeds and Percentage of Samples									
		1st		2nd		3rd		4th		5th	
Tall fescue	3101	Ryegrass	34%	Annual bluegrass	6%	Orchardgrass	3%	Downy brome	2%	Hairy chess	2%
Perennial ryegrass	2077	Annual ryegrass	56%	Annual bluegrass	11%	Rattail fescue	7%	Fine fescue	3%	Tall fescue	2%
Kentucky bluegrass	403	Rough bluegrass	8%	Annual bluegrass	4%	Witchgrass	3%	Henbit	3%	Ryegrass	3%
Orchardgrass	200	Ryegrass	57%	Tall fescue	35%	Annual bluegrass	29%	Rough bluegrass	13%	Curly dock	10%
Wheat	52	Brassica sp.	12%	Oat	4%	Barley	2%	Ryegrass	2%	Barnyardgrass	2%
Red fescue	72	Rattail fescue	38%	Downy brome	17%	Ryegrass	10%	Annual bluegrass	6%	Bulbous bluegrass	4%
Chewings fescue	81	Rattail fescue	32%	Ryegrass	6%	Field chamomile	4%	Sedge	2%	Tall fescue	2%
Colonial bentgrass	78	Velvetgrass	14%	Western yellowcress	13%	Toad rush	10%	Rough bluegrass	9%	Speedwell	8%
Creeping bentgrass	43	Willowherb	2%	Wild carrot	2%	Shepherdspurse	2%	Annual bluegrass	2%	Common groundsel	2%
Hard fescue	53	Rattail fescue	45%	Ryegrass	15%	Annual bluegrass	13%	Spotted cat's-ear	9%	Sedge	6%
Annual ryegrass	143	Annual bluegrass	18%	Perennial ryegrass	17%	Rattail fescue	10%	Wild oat	4%	Tall fescue	3%
Rough bluegrass	47	Kentucky bluegrass	19%	Windgrass	6%	Rattail fescue	6%	Henbit	4%	Pigweed	2%
Oat	11	Wheat	9%	Wild radish	9%	Common wheat	9%	Wild buckwheat	9%	not applicable	

Prevalent Contaminants in Seed Crops (2000 – 2003 contd.)

2003	Number tested	Prevalent Contaminant Seeds and Percentage of Samples									
		1st		2nd		3rd		4th		5th	
Tall fescue	2223	Ryegrass	34%	Annual bluegrass	5%	Hairy chess	3%	Orchardgrass	3%	Curly dock	2%
Perennial ryegrass	2102	Annual ryegrass	68%	Annual bluegrass	11%	Rattail fescue	8%	Fine fescue	4%	Tall fescue	3%
Kentucky bluegrass	287	Rattail fescue	13%	Rough bluegrass	7%	Henbit	4%	Witchgrass	3%	Downy brome	3%
Wheat	54	Bedstraw	4%	Ryegrass	2%	Downy brome	2%	Tall fescue	2%	--	--
Orchardgrass	153	Ryegrass	76%	Annual bluegrass	43%	Tall fescue	39%	Mountain brome	8%	Rough bluegrass	8%
Red fescue	47	Rattail fescue	47%	Ryegrass	9%	Downy brome	9%	Kentucky bluegrass	9%	Henbit	6%
Colonial bentgrass	103	Toad rush	37%	Velvetgrass	19%	Sticky mouse-ear	17%	Western yellowcress	16%	Rough bluegrass	9%
Chewings fescue	37	Rattail fescue	32%	Ryegrass	11%	Field chamomile	8%	Henbit	3%	Trefoil	3%
Creeping bentgrass	19	Annual bluegrass	16%	Willowherb	11%	Western yellowcress	11%	Common plantain	5%	Colonial bentgrass	5%
Rough bluegrass	71	Kentucky bluegrass	20%	Rattail fescue	14%	Windgrass	8%	Annual bluegrass	3%	Henbit	1%
Annual ryegrass	65	Perennial ryegrass	20%	Soft chess	8%	Tall fescue	8%	Toad rush	6%	Mannagrass	6%
Barley	4	Wheat	25%	--	--	--	--	--	--	--	--

* Values are listed for crops exceeding 1000 acres of certification production. Test data is derived from OSU Seed Laboratory evaluation of original certified samples representing Oregon production. Values for Perennial and Annual ryegrass are based on mechanical purity exam, and are not restated according to the fluorescence or grow-out results.

2000 – 2003 Summary of contaminant ranking*

2000	Percentage of Samples
Annual ryegrass	24.6%
Ryegrass	15.6%
Annual bluegrass	8.9%
Rattail fescue	8.2%
Downy brome	3.5%
Kentucky bluegrass	2.7%
Tall fescue	1.7%
Orchardgrass	1.7%
Curly dock	1.7%
Rough bluegrass	1.6%

2001	Percentage of Samples
Annual ryegrass	21.8%
Ryegrass	14.3%
Rattail fescue	5.8%
Annual bluegrass	5.4%
Downy brome	2.7%
Kentucky bluegrass	1.6%
Bedstraw	1.6%
Orchardgrass	1.6%
Tall fescue	1.5%
Curly dock	1.1%

2002	Percentage of Samples
Ryegrass	20.1%
Annual ryegrass	19.9%
Annual bluegrass	9.1%
Rattail fescue	5.5%
Downy brome	2.1%
Tall fescue	2.0%
Kentucky bluegrass	1.7%
Rough bluegrass	1.6%
Orchardgrass	1.6%
Fine fescue	1.5%

2003	Percentage of Samples
Annual ryegrass	27.9%
Ryegrass	17.7%
Annual bluegrass	9.2%
Rattail fescue	6.1%
Tall fescue	2.6%
Hairy chess	2.2%
Fine fescue	2.1%
Downy brome	1.8%
Curly dock	1.4%
Rough bluegrass	1.3%

* Test data is derived from OSU Seed Laboratory evaluation of original certified samples representing Oregon production.

Appendix F. Potential environments affected, direct, indirect and cumulative effects for the deregulation of glyphosate tolerant creeping bentgrass (GTCB)

Affected Environments	Potential Direct Impacts	Potential Indirect Impacts	Potential Cumulative Impacts
1) Ecologically sensitive areas: Riparian/ wetlands and Grasslands	• None	• Establishment of GTCB via vegetative propagules, seed movement or hybridization with resident *Agrostis* species • Alternate herbicide or other methods required for removal • Cost, efficacy and safety of alternate control measures	• Loss/reduction of native species through competition with *Agrostis* species • Loss/reduction of other plant or animal species through reduction in native species
2) Threatened plant species	• None	• Establishment of GTCB via vegetative propagules, seed movement or hybridization with threatened *Agrostis* species • Alternate herbicide or other methods required for removal • Cost, efficacy and safety of alternate control measures	• Loss/reduction of threatened species through competition or hybridization • Loss/reduction of other plant or animal species through reduction in native species

Potential environments affected, direct, indirect and cumulative effects for the deregulation of GTCB (contd.)

Affected Environments	Potential Direct Impacts	Potential Indirect Impacts	Potential Cumulative Impacts
3) Golf courses/ recreation	• Improved weed/pest management • Use of herbicide active ingredient with favorable environmental characteristics • Reduced use of pesticides with less desirable safety characteristics • Enhanced playability • Enhanced aesthetics • Cost savings	• Reduced water use • Impact on nontarget organisms from reduced use of other pesticides • Enhanced applicator and golfer safety • Reduction in turf weed seed on golf courses treated with glyphosate • Reduction in biodiversity of weeds on golf course • Reduction in pollen-related allergens from weed species controlled by glyphosate • Reduction in pesticide runoff to surface or ground water	• Enhanced ability to realize benefits of turf • Reduction in the spread of weeds to public and private lands • Reduction in the application and human exposure to pesticides applied to control weeds on public and private lands
4) Residential/Urban areas	• Exposure to fewer pesticide treatments if home is adjacent to golf course	• Reduction in the spread of weeds to public and private lands	• Reduction in the application and human exposure to pesticides applied to control weeds on public and private lands • Reduction in pesticide runoff to surface or ground water

Potential environments affected, direct, indirect and cumulative effects for the deregulation of GTCB (contd.)

Affected Environments	Potential Direct Impacts	Potential Indirect Impacts	Potential Cumulative Impacts
5) Traditional agriculture	• None	• Reduction in the spread of weeds to agricultural areas	• Reduction in the application and human exposure to pesticides applied to control weeds on public and private lands • Reduction in pesticide runoff to surface or ground water
6) Organic Agriculture	• None	• None	• None
7) Children, minorities and low-income populations	• None	• Increased exposure of golfers and golf course labor to glyphosate • Reduced exposure of golfers and golf course labor to pesticides with less favorable safety characteristics than glyphosate	• Reduction in worker exposure pesticide -related illnesses

Potential environments affected, direct, indirect and cumulative effects for the deregulation of GTCB (contd.)

Affected Environments	Potential Direct Impacts	Potential Indirect Impacts	Potential Cumulative Impacts
8) Human health	• None	• None	• Reduced exposure of residents with homes adjacent to golf course to pesticides with less favorable safety characteristics than glyphosate
9) Water quality	• None	• None	• Reduced exposure of groundwater to pesticides with less favorable safety characteristics than glyphosate
10) Soil quality	• None	• None	• Reduced exposure of soil to pesticides with less favorable safety characteristics than glyphosate
11) Wildlife	• None	• None	• Reduced exposure to water in which pesticides with less favorable safety characteristics than glyphosate have consolidated
12) Aesthetic enjoyment of outdoors	• None	• None	• None

Appendix G. Weeds of Golf Courses and their U.S. Weed Status[1,2,4]

Scientific Name	Common Name	Nativity in US[3]	STATE	FLEPPC	HEAR	KY	NE&GP	N'EAST	SEEPPC	SWSS	WI	WSWS
Poa annua	annual bluegrass	I					NE&GP	N'EAST		SWSS		WSWS
Echinochloa crus-galli	barnyard grass	I	AR			KY	NE&GP	N'EAST		SWSS		WSWS
Digitaria sanguinalis	hairy crabgrass	N				KY	NE&GP	N'EAST		SWSS		WSWS
Digitaria ischaemum	smooth crabgrass	I					NE&GP			SWSS		
Paspalum dilatatum	dallis grass	I						N'EAST		SWSS		WSWS
Setaria viridis	green foxtail	I	CO				NE&GP		SEEPPC	SWSS		
Eleusine indica	goosegrass	I				KY	NE&GP	N'EAST		SWSS		WSWS
Sorghum halepense	Johnsongrass	I	AR, CA, CO, DE, ID, IL, IN, KS, MD, MO, NV, OH, OR, PA, SD, UT, WA, WV			KY	NE&GP	N'EAST	SEEPPC	SWSS		WSWS
Muhlenbergia schreberi	nimblewill	N	CA			KY	NE&GP	N'EAST		SWSS		
Cyperus esculentus	yellow nutsedge	NI	CA, CO, HI, OR, WA			KY	NE&GP	N'EAST		SWSS		WSWS
Elymus repens	quackgrass	I	AK, AZ, CA, HI, IA, KAS, OR, UT, WY			KY	NE&GP			SWSS		
Bromus catharticus	rescue grass	I							SEEPPC	SWSS		WSWS
Cenchrus echinatus	field sandbur	N	AZ, CA		HEAR					SWSS		
Sporobolus indicus	smut grass	NI								SWSS		
Panicum repens	torpedo grass	N	AL, AZ, HI	FLEPPC								
Holcus lanatus	velvetgrass	I			HEAR			N'EAST				WSWS

Appendix G. Contd.

Scientific Name	Common Name	Nativity In US[3]	STATE	FLEPPC	HEAR	KY	NE&GP	N'EAST	SEEPPC	SWSS	WI	WSWS
Stellaria media	common chickweed	I				KY	NE&GP	N'EAST		SWSS		WSWS
Cerastium fontanum	mouseear chickweed	I					NE&GP	N'EAST		SWSS		
Trifolium repens	white clover	I					NE&GP	N'EAST				
Bellis perennis	lawn daisy	I						N'EAST				WSWS
Taraxacum officinale	dandelion	NI				KY	NE&GP	N'EAST		SWSS		WSWS
Rumex crispus	curly dock	I	AR, IA			KY	NE&GP	N'EAST		SWSS		WSWS
Glechoma hederacea	ground ivy	I				KY	NE&GP	N'EAST			WI	
Prunella vulgaris	healall	N					NE&GP	N'EAST				
Lamium amplexicaule	henbit	I				KY	NE&GP	N'EAST		SWSS		WSWS
Polygonum aviculare	prostrate knotweed	I				KY		N'EAST		SWSS		WSWS
Malva neglecta	common mallow	I				KY	NE&GP	N'EAST		SWSS		WSWS
Medicago lupulina	hop medic	I				KY	NE&GP	N'EAST		SWSS		WSWS
Sagina procumbens	birdseye pearlwort	I						N'EAST				
Plantago major	broadleaf plantain	N						N'EAST				WSWS
Plantago lanceolata	buckhorn plantain	I	AR, IA			KY	NE&GP	N'EAST		SWSS		WSWS
Portulaca oleracea	common purslane	N	AZ		HEAR	KY	NE&GP	N'EAST		SWSS		WSWS
Capsella bursa-pastoris	shepardspurse	I	CO			KY	NE&GP	N'EAST		SWSS		WSWS
Rumex acetosella	sheep sorrel	I	AR, IA				NE&GP	N'EAST		SWSS		WSWS
Veronica arvensis	common speedwell	I					NE&GP	N'EAST				
Veronica filiformis	creeping speedwell	I						N'EAST				
Veronica peregrina	purslane speedwell	N										WSWS
Chamaesyce maculata	spotted spurge	N					NE&GP	N'EAST		SWSS		
Daucus carota	wild carrot	I	IA, MI, OH, WA			KY	NE&GP	N'EAST	SEEPPC	SWSS		WSWS
Allium vineale	wild garlic	I	AR, CA, HI			KY		N'EAST	SEEPPC	SWSS		
Achillea millefolium	common yarrow	NI				KY	NE&GP	N'EAST		SWSS		

Footnotes

[1] Weeds of golf courses identified in: Beard, J. 1982. Pests and stresses. In: Turf Management for Golf Courses, Chapter 10, pp. 377-403. Publication of the United States Golf Association, Burgess Publishing Co. Minneapolis, MN.

[2] U.S. weed status cited from: USDA. 2004. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

[3] N =Native, NI=some populations native, some introduced, I =Introduced

[4] Key to abbreviations:

US	Federal Noxious Weed List
STATE	State noxious weed lists for 35 states
FLEPPC	Florida Exotic Pest Plant Council, Invasive plant list
HEAR	Hawaiian Ecosystems at Risk Project, Information index for selected alien plants in Hawaii
KY	Weeds of Kentucky and adjacent states: A field guide
NE&GP	Weeds of Nebraska and the Great Plains
N'EAST	Weeds of the Northeast
SEEPPC	Southeast Exotic Pest Plant Council, Invasive exotic pest plants in Tennessee
SWSS	Southern Weed Science Society, Weeds of the United States and Canada
WI	Wisconsin manual of control recommendations for ecologically invasive plants
WSWS	Weeds of the West

Appendix H. Literature cited

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